Vascular Plants and Vegetation of the Sayula sub-basin, Jalisco, Mexico

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Abstract

Background: The Sayula sub-basin presents a complex landscape composed of plants communities that to date have not been studied in a timely manner, so this study contributes to the knowledge of the flora and vegetation of the area and the State.

Question: i) How many and which families, genera and species are in the Sayula sub-basin? ii) What are the main biological forms of the species? iii) Are there species under any category of protection? iv) How many vegetation types are present within the region?

Studied species: Ferns, Gymnosperms and Angiosperms.

Study site and years of study: The Sayula sub-basin, Jalisco, Mexico; from February 2012 to October 2015.

Methods: Through the literature review and field work the floristic checklist was elaborated. In addition, with the use of geographic information systems, a map of land use and vegetation was made.

Results: A total of 687 species were recorded, including 415 genera and 113 families. The five main families were Poaceae, Asteraceae, Fabaceae Solanaceae and Euphorbiaceae representing 42.6 % of the total species and 36.6 % of the genera. It should be noted that the predominant biological forms were herbs with 409, 105 shrubs and 74 trees. On the other hand, 47 species registered under some protection category of which, only one species *Cleomella jaliscensis* is endemic to the region. Finally, eight vegetation types were determined, being the tropical deciduous forest the one that occupies greater surface and presents greater floristic diversity.

Conclusions: It is important to emphasize that during the realization of the work, agricultural activities were detected affecting the flora and vegetation, threatening the biodiversity and the natural balance of the region.

Key words: Floristic richness, phytogeography, plant communities, western Mexico.

Resumen

Antecedentes: La subcuenca Sayula, presenta un complejo paisaje conformado de comunidades vegetales que a la fecha, no han sido estudiadas de manera puntual, por lo que este estudio contribuye al conocimiento de la flora y vegetación de la zona y del Estado.

Pregunta: i) ¿Cuántas y cuáles familias, géneros y especies se encuentran en la Subcuenca Sayula? ii) ¿Cuales son las principales formas biológicas que presentan las especies? iii) ¿Existen especies bajo alguna categoría de protección? iv) ¿Cuantos tipos de vegetación se presentan dentro de la región?

Especies de estudio: Helechos, Gimnospermas y Angiospermas.

Sitios de estudio y años de estudio: La subcuenca Sayula, Jalisco, México; desde febrero de 2012 hasta octubre de 2015.

Métodos: Mediante la revisión de literatura y trabajo de campo se elaboró el listado florístico. Además, con el uso de sistemas de información geográfica se realizó un mapa de uso de suelo y vegetación.

Resultados: Se registraron un total de 687 especies, incluidas en 415 géneros y 113 familias. Las cinco principales familias fueron Poaceae, Asteraceae, Fabaceae Solanaceae y Euphorbiaceae que representan el 42.6 % del total de las especies y el 36.6 % de los géneros. Cabe resaltar que las formas biológicas predominantes fueron las hierbas con 409, 105 arbustos y 74 árboles. Por otra parte, se registraron 47 especies bajo alguna categoría de protección de las cuales sólo una especie es endémica de la región *Cleomella jaliscensis*. Finalmente, se determinaron ocho tipos de vegetación, siendo el bosque tropical caducifolio el que ocupa mayor superficie y presenta mayor diversidad florística.

Conclusiones: Es importante destacar que durante la realización del trabajo, se detectaron actividades agropecuarias que afectan la flora y vegetación, amenazando así la biodiversidad y el equilibrio natural de la región.

Palabras Clave: Comunidades vegetales, fitogeografía, occidente de México, riqueza florística.

Mexico is considered a megadiverse country (Mittermeier 1988, Rzedowski 1998, Villaseñor 2003), within its territory are registered a total of 1,014 species of pteridophytes (Martínez-Salas & Ramos 2014), 54 species of Zamiaceae (Nicolalde-Morejón *et al*. 2014), 94 species of conifers (Gernandt & Pérez de la Rosa 2014) and 21,841 of angiosperms (Villaseñor & Ortiz 2014). A total of 23,003 species place the country in the fifth place in the world in terms of vascular plants. Their diversity is gradually being known, described and reported, albeit at a slow pace, not matched by the rate of destruction of the ecosystems where they thrive (Villaseñor 2004). It is estimated that about 30 % of the national territory has not been studied floristically and there are still little explored areas (Sosa & Dávila 1994).

In western Mexico, although Jalisco is one of the states of the Mexican Republic with the greatest wealth of flowering plants, it ranks fourth in the national level with ca. 5,931 species of Magnoliophyta, below the states of Oaxaca (9,019), Chiapas (7,830) and Veracruz (6,876) and occupy the third place in endemic plants with 315 (Villaseñor & Ortiz 2014). To the date, in spite of already having a Catalog of Vascular Plants of Jalisco, it is estimates that only 60 % of the territory of Jalisco is known, so there are still areas that have been poorly explored botanically (Sierra del Cuale, north of Jalisco), because of the above, the number of species may increase in later studies (Ramírez-Delgadillo *et al*. 2010).

In the state and particularly in the Sayula sub-basin, there is a strong pressure on natural resources, especially on vegetation cover, caused by anthropogenic activities such as deforestation, agriculture and livestock, negatively impacting their biodiversity.

The vegetation of the sub-basin, was initially known only the information presented by (CETENAL 1976), in its land use charts, in which the lacustrine vessel appears as erial land (without crop) with halophytic vegetation and areas bordering as deciduous forest.

Estrada-Faudón (1983) made a geographical study of the two lacustrine islands in the municipality of Atoyac, in it, describes the different types of vegetation found and mentions the floristic component of each one of them. In the same year, Jiménez-Calderón (1983) elaborates a study of the halophilic plants of the endoreic Zacoalco-Sayula sub-basin in which it registers 69 species. Later in the same basin, Delgado (1984) makes a study of the halophilic plants and their relation with the edaphic characteristics, in which it reports that *Distichlis spicata*, *Oligomeris linifolia*, *Sporobolus pyramidatus* and *Sueda diffusa* are indicative of saline soils; González-Villarreal & Pérez de la Rosa (1987) in their work refer to the basin, in which they mention the different types of vegetation, the strata found and the characteristic flora of each of them along the same; Arámbula & Preciado (1989) carry out a study on the potential uses of the halophytic vegetation of the region; Estrada-Faudón (1993) makes a study on the vegetation of the lagoon focused on its problem and proposes alternatives.

The first systematic botanical study of the Laguna was done by Villegas-Flores *et al*. (1995) in which they describe the different types of vegetation and provide a floristic listing of the study area; Arreola-Nava & Villegas-Flores (1996) make an inventory of the wild and cultivated cacti of the Laguna, registering a total of 16 species, emphasizing its ethnobotanical aspects; Villegas-Flores & Ramírez-Delgadillo (1998) describe a new species of *Cleomella* (Cleomaceae), from this area; Macías-Rodríguez (2001) elaborates a list of 37 succulent plants registered in the Lagoon, and includes information of the habitat and vegetation type where they are; The same author publishes (2004) an illustrated book on the vegetation and flora of the Lagoon; Contreras-Rodríguez *et al*. (2013) publish guide of grasses covering the entire Sayula sub-basin, both the Laguna and surrounding sierras, registering a total of 82 species; finally Macías-Rodríguez (2016) makes an inventory of the succulent plants of the entire Sayula sub-basin, where it registers 70 species, of which the dominant biological forms are herbs and shrubs, mainly occurring in the thorny forest and tropical deciduous forest.

Due to the above, the present work has as objectives, to make a floristic inventory, and to determine and characterize the vegetation types.

Materials and methods

Study area. The sub-basin is located in the center-south portion of the State, at a distance of approximately 60 km toward south from the city of Guadalajara. The area encompasses part

Author contributions
Miguel Ángel Macías-Rodríguez: Conceived, designed, collected and identified the pteridophytes, and some botanical families and drafted the project.
Hector Gerardo-Frías Ureña: Elaborated the map and description of the vegetation, revised the draft.
Sergio Honorio Contreras-Rodríguez: Collected and identified grasses and some botanical families, revised the draft.
Alfredo Frías-Castro: Collected and identified some botanical families and analyzed the data on floristic wealth, revised the draft.

of the municipalities of Amacueca, Atoyac, Concepción de Buenos Aires, Gómez Farías, Sayula, Techaluta de Montenegro, Teocuitatlán de Corona and Zacoalco de Torres. It is located between the coordinates 19°45' and 20°15' north latitude and between the coordinates 103°10' and 103°45' west longitude. It has an area of 147,585.3 ha, with an altitudinal variation ranging from 1,110 to 2,868 m (Figure 1).

Physiographically, it is part of the Chapala subprovince of the Eje Neovolcánico province in the western part of the country. It is classified as an endorheic basin, consisting mainly of the Tapalpa and Tigre ranges, and the water outlet is only by infiltration or evapotranspiration. Rainfall is the main source of water in the lagoon, which becomes brackish water by the salts of the soil, like Na_2CO_3 and $MgSO_4$ (Flores-Díaz 1984).

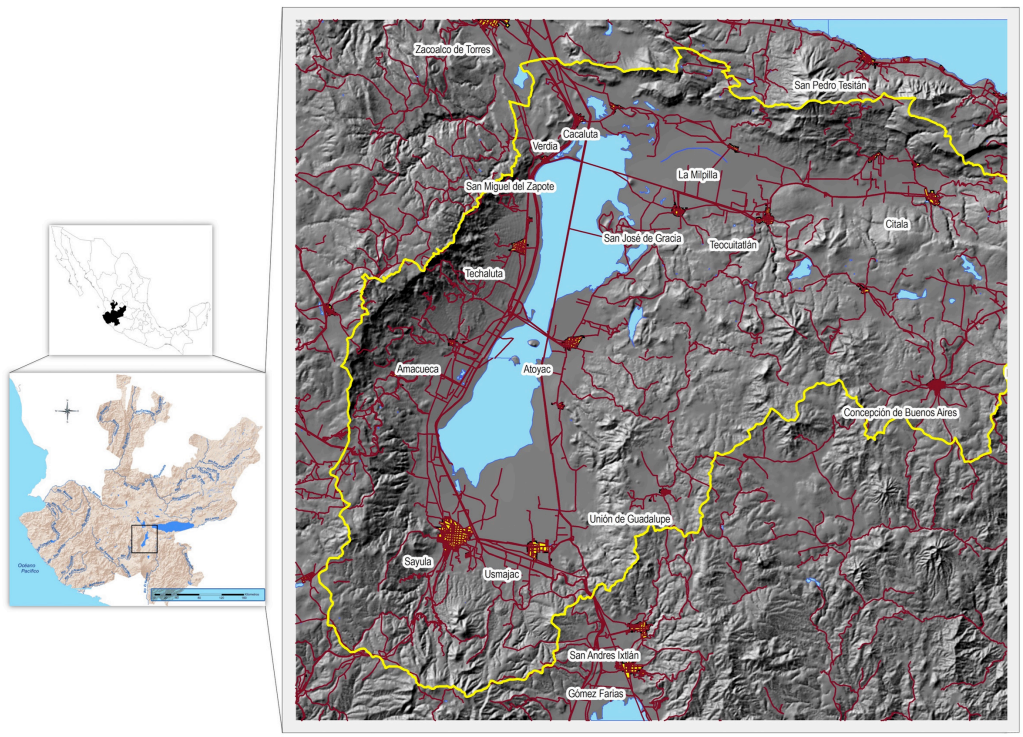

Figure 1. Location of the study area.

The lithology is mainly of igneous basic extrusive origin, provided in the form of lava, tuff and breccias. A basaltic and andesite composition prevails on the slopes surrounding the lacustrine vessel, acid rocks, the product of explosive expulsions of rapid cooling, predominate in the upper parts of the Sierras del Tigre and Tapalpa. In the low points of the slopes are sandstones and shales (Flores-Díaz 1984). The so-called "islands" are recent extrusions of afritic basalt of labradorite and olivine, and to a lesser extent of andesites (Ávila 1994).

In foothills and moderately steep slopes, predominant fluvisoles soils and calcium. The solonchaks soils are distributed over the lacustrine sediments of the basin, to the north of the saline plain they form a mosaic with the arenosols, by the deposit of sands removed from another part of the plain by wind erosion. (SPP 1982).

In the lower part of the sub-basin, climatic subtypes predominate, according to Köppen, semi-dry BS_1hw (w) and sub-humid (A)C(w_0) w. The average annual temperature is 21.5 °C in the southern sub-basin, rising to 22.7 °C to the north and the annual mean rainfall is 564.6 mm in the north, rising to 851.1 mm to the south. In the summits of the sub-basin the climate type is subhumid temperate C(w_1)(w) and C(w_2)(w), the average humidity and the wetter subhumid temperate, respectively), with summer rains and less of five percent of winter rain. Concerning the tops with altitude under 2,000 m the annual average temperature is 16.2 °C and the annual rainfall is 802.8 mm. In the highest tops the average annual temperature is 15.2 °C and the average annual rainfall is 843.9 mm (García 1988).

Fieldwork and Cabinet. Several collections of botanical specimens were made within the study area, from February 2012 to October 2015, of at least one output per month, lasting four days, during which several routes were made through the breaches, trails and roads within the municipalities that are part of the sub-basin. Only native and naturalized plants were collected, discarding the cultivated species. The collected specimens were herborized according to the methodologies proposed by Lot & Chiang (1986) and Sánchez-González & González (2007) and deposited in the herbarium of the Institute of Botany of the University of Guadalajara (IBUG). For the determination of the species, taxonomic literature was used as different books, monographs and floras: Trees and shrubs of Mexico (Standley 1920-1926); Flora de Jalisco (Cuevas-Figueroa 2001, Cervantes-Aceves 1992, González-Villarreal 1986, 1990, 1996, González *et al*. 2001, and Vargas *et al*. 2003), Flora del Bajío y Regiones Adyacentes; Flora Novogaliciana (McVaugh 1983, 1984, 1985, 1987, 1989, 1992, 1993, 2001); Flora fanerogámica del Valle de México (Calderón de Rzedowski & Rzedowski 2001); The Pteridophytes of Mexico (Mickel & Smith 2004) and Conifers (Farjón *et al*. 1997, Gernandt & Pérez de la Rosa 2014). In addition to the support of specialists from different families for their determination.

The families, genera, species, subspecies and varieties are presented in alphabetical order according to the classification criteria proposed by Mickel & Smith (2004) for ferns, Gernandt & Pérez de la Rosa (2014) for conifers, and related plants APG IV (2016) for angiosperms. The names of the species are cited according to the database Taxonomic Name Resolution Service v4.0 (Boyle *et al*. 2013).

For each species, bibliographical information was collected concerning their life form, habitat, native or introduced, distribution, conservation status and vegetation type. To establish the categories of life forms the criterion proposed by Rzedowski (1978) with some modifications was followed. The geographic distribution of the species recorded through the literature review was analyzed and 12 distribution patterns were determined, grouping them into the following elements: 1) cosmopolitan, 2) pantropical, 3) American, 4) North American, 5) from Mexico to South America, 6) from the United States to Central America, 7) from Mexico to Central America, 8) from the United States to Mexico, 9) neotropical, 10) endemic to Mexico, 11) disjunct, and 12) endemic to western Mexico. The information regarding the distribution by vegetation types was obtained based on the literature and the records of the plant communities where the species were collected. Finally, species included in a category of the International Union for Conservation of Nature (IUCN), International Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES) and/or the Mexican Official Standard (SEMARNAT 2010) was recorded.

In order to have a parameter of the vegetal diversity of the present study, the richness of species was compared with other areas of different surface that have floristic inventories. For this purpose we worked with the taxonomic biodiversity index, whereby an approximation was obtained of the number of taxa presented in the area studied according to their surface, using the formula $B = S / lnA$, where S is the number of recorded species and lnA is the natural logarithm of the area in km^2 (Squeo *et al*. 1998).

Based on the information generated by the LANDSAT 8 images, a soil occupation map of the study area was elaborated using the supervised classification methodology in the ArcMap 10 geographic information system, which was subsequently verified in countryside. The vegetation of the study area was characterized according to the proposal of Rzedowski (1978).

Results

Floristic diversity. The flora of the Sayula sub-basin is represented by 113 families, 415 genera and 687 species (Appendix 1). The group of Eudicots was the one with the highest richness with 79 families (representing 69.9 % of the total), 303 genera and 491 taxa, followed by Monocots, Monophyllites, Pinophytes and Magnoliidae complexes (Table 1).

The most diverse family was Poaceae, with 103 species and 46 genera, followed by Asteraceae (81/58), Fabaceae (47/31), Solanaceae (38/10) Euphorbiaceae (25/7), Malvaceae (20/12), Cactaceae (18/10), Lamiaceae (18/9) and Convolvulaceae (16/6). These nine families represent 53.3 % (366) of the species and 45.5 % (189) of the genera. The remaining 104 families recorded less than 14 species each (Table 2). The genera with the highest number of species were

Table 1. Richness by taxonomic groups within the flora present in the study area

Group	Families	Genera	Species	Var./ssp.
Lycopodiophyta	1 (0.9 %)	1 (0.2 %)	1 (0.1 %)	-
Monilophyta	10 (8.8 %)	18 (4.3 %)	23 (3.3 %)	-
Pinophyta	2 (1.8 %)	2 (0.5 %)	7 (1.0 %)	-
Magnoliide	5 (4.4 %)	5 (1.2 %)	5 (0.7 %)	-
Monocots	16 (14.2 %)	85 (20.5 %)	159 (23.1 %)	5
Eudicots	79 (69.9 %)	304 (73.3 %)	492 (71.6 %)	14
Total	**113**	**415**	**687**	**19**

Solanum with 21, *Euphorbia* with 14, *Quercus* with 11, *Ipomoea* with 10, *Salvia* with nine, *Ficus*, *Muhlenbergia* and *Opuntia* with eight and *Bouteloua*, *Bursera*, *Cenchrus*, *Paspalum*, and *Pinus* with six. In these 13 genera, 17.3 % (119) of the species recorded in the study area are represented. For the rest of the genera (402) all presented less than five species (Table 2).

Table 2. Families and genera best represented in the flora of the study area.

Families	Species/Genera	Genera	Number of Species
Poaceae	103/46	*Solanum*	21
Asteraceae	81/58	*Euphorbia*	14
Fabaceae	47/31	*Quercus*	11
Solanaceae	38/10	*Ipomoea*	10
Euphorbiaceae	25/7	*Salvia*	9
Malvaceae	20/12	*Ficus*	8
Cactaceae	18/10	*Muhlenbergia*	8
Lamiaceae	18/9	*Opuntia*	8
Convolvulaceae	16/6	*Bouteloua*	6
Amaranthaceae	14/8	*Bursera*	6
Boraginaceae	12/8	*Cenchrus*	6
Aspargaceae	11/7	*Paspalum*	6
Cyperaceae	11/6	*Pinus*	6

Biological forms. The herbs are the dominant biological form with 411 which accounts for 60 % of the total species, followed by shrubs with 105 (15 %), trees with 73 (11 %) are followed in number of importance vines, succulents, lianas, rosettes and cane (Table 3). The dominant plants according to the type of habitat in which they develop 635 are terrestrial, 25 aquatic, 9 rupicolous (ferns), 9 parasites (mistletoe and cuscuta) and 9 epiphytes (Appendix 1).

Of the total species recorded in the sub-basin, 94.1 % (647) are native to Mexico and 5.9 %

Table 3. Richness of the biological forms present in the flora of the Sayula sub-basin

Biological forms	Number of Species	Percentage
Herb	411	59.8
Shrub	105	15.3
Tree	73	10.6
Vine	35	5.1
Suffrutex	33	4.8
Succulent	18	2.6
Liana	6	0.9
Rosette	4	0.6
Cane	2	0.3
Total	**687**	**100**

(40) are introduced. For the synanthropic species (weeds or disturbance indicators), 307 (44.7 %) of which 270 are native and 37 are introduced (Appendix 1). Of these weeds, 223 (72.6 %) are herbaceous, 35 shrubs (11.4 %) and 19 suffrutexs (6.2 %), vines 16 (5.2 %), trees 10 (3.3 %), lianas 3 (1 %) and cane 1 (0.3 %).

Species under some category of protection. Result of the review of several lists of protected or threatened species such as the International Union for Conservation of Nature (IUCN 2015), International Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES 2013) and Official Mexican Standard (SEMARNAT 2010), a total of 46 species were registered under some protection category. Some species are found in more than one listing, such as *Callitropsis lusitanica*, *Hylocereus undatus*, *Isolatocereus dumortieri* and *Myrtillocactus geometrizans* (Table 4).

Geographic distribution. Based on 687 species and the establishment of 12 distribution patterns, 171 species (24.9 %) endemic to Mexico were recorded, of which four are pteridophytes, three gymnosperms, two of the magnoliidae complex, 136 eudicots and 26 monocots. For the non-endemic to Mexico, 147 (21.4 %) are distributed in the American continent, 133 (19.4 %), whose distribution goes from Mexico to Central America. 8.3 % (57) are widely distributed or cosmopolitan species, 6.1 % (42) are distributed in the neotropic; For the rest of the species these are distributed in six different patterns (Table 5). Only nine species (1.3 %) are endemic to western Mexico and a single species endemic to the sub-basin, *Cleomella jaliscensis* (Appendix 1).

Floristic richness. According to the index of taxonomic diversity, the area have a floristic richness of 94 species per km^2. A comparison with other similar studies in areas dominated by tropical deciduous forest such as the Baja California Peninsula (León de la Luz *et al*. 2012) or the Nixticuil-San Esteban-El Diente Forest Hydrological Protection area (Zepeda & Velázquez 1999), allows estimating that the floristic richness of the Sayula sub-basin is a little higher, but it is far below compared to the Balsas River Basin and Cerro Viejo; Although these assessments

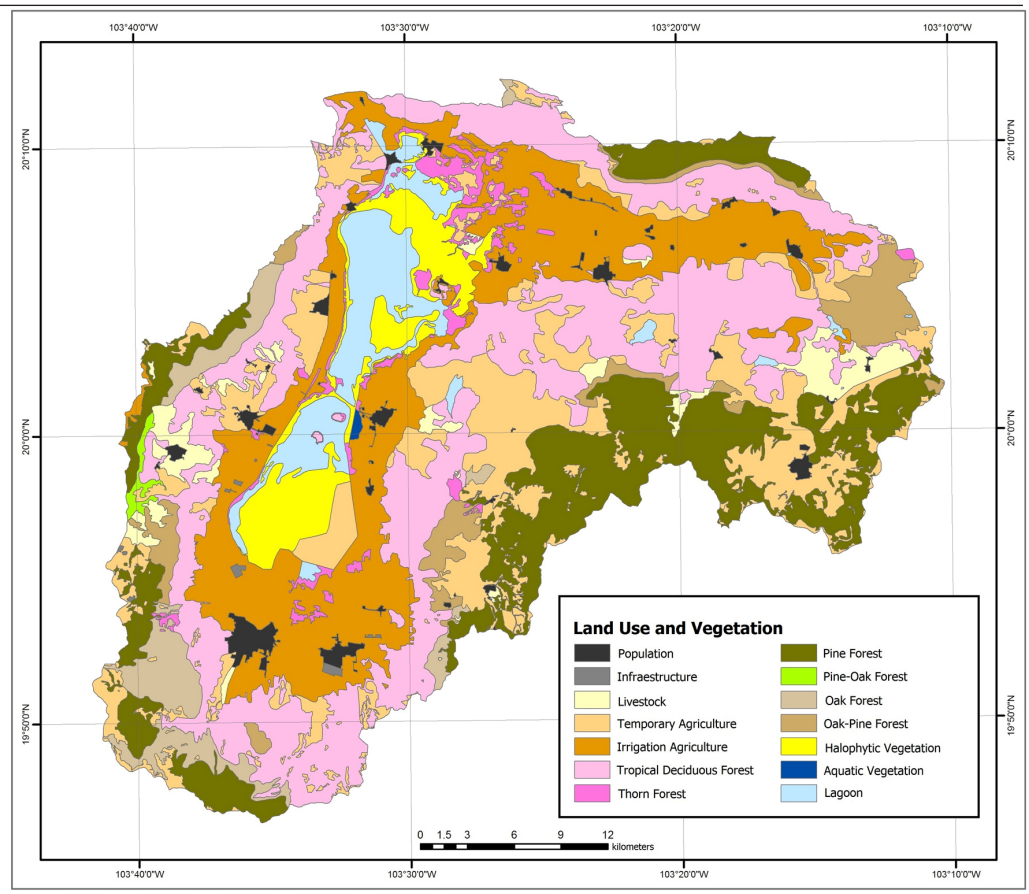

Figure 2. Land use and vegetation map of the Sayula sub-basin, Jalisco, Mexico.

Table 4. Species with some category of protection according to the International Union for Conservation of Nature (IUCN 2015); Mexican Official Standard NOM-059-SEMARNAT-2010 (SEMARNAT 2010) or the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES 2013) located in the Sayula sub-basin, Jalisco, Mexico. IUCN: International Union for Conservation of Nature, DD: Insufficient data, LR: Low Risk, LC: Minor Concern, NT: Nearly threatened, VU: Vulnerable; NOM: Official Mexican Standard, P: Extinguishing Hazard, A: Threatened; Pr: Subject to Special Protection, CITES: Convention on International Trade in Endangered Species of Wild Flora and Fauna, II: Included in Appendix II.

Species	Families	Protection Category	Distribution	Population Trend
1. *Adiantum capillus-veneris*	Adiantaceae	IUCN-LC	-	Stable
2. *Alnus acuminata*	Betulaceae	IUCN-LR	-	-
3. *Alnus jorullensis*	Betulaceae	IUCN-LC	-	Stable
4. *Arbutus glandulosa*	Ericaceae	IUCN-LR	-	-
5. *Berula ereta*	Apiaceae	IUCN-LC	-	Stable
6. *Callitropsis lusitanica*	Cupressaceae	IUCN-LC/NOM (Pr)	Not Endemic	Unknown
7. *Chiococca alba*	Rubiaceae	IUCN-LC	-	Unknown
8. *Comarostaphylis discolor*	Ericaceae	IUCN-LR	-	-
9. *Cyperus digitatus*	Cyperaceae	IUCN-LC	-	Stable
10. *Dalea ovatifolia*	Fabaceae	IUCN-LC	-	Stable
11. *Eysenhardtia polystachya*	Fabaceae	IUCN-LC	-	Stable
12. *Hylocereus purpusii*	Cactaceae	CITES- II	-	-
13. *Hylocereus undatus*	Cactaceae	IUCN-DD/CITES - II	-	Unknown
14. *Isolatocereus dumortieri*	Cactaceae	IUCN-LC/CITES- II	-	Stable
15. *Laelia autumnalis*	Orchidaceae	CITES - II	-	-
16. *Laelia speciosa*	Orchidaceae	CITES- II/NOM (Pr)	Endemic	-
17. *Leptochloa fusca*	Poaceae	IUCN-LC	-	Stable
18. *Lysiloma acapulcense*	Fabaceae	IUCN-LC	-	Stable
19. *Mammillaria scrippsiana*	Cactaceae	CITES- II	-	-
20. *Myrtillocactus geometrizans*	Cactaceae	IUCN-LC/CITES- II	-	Stable
21. *Nopalea cochenillifera*	Cactaceae	IUCN-DD/CITES- II	-	Unknown
22. *Opuntia atropes*	Cactaceae	CITES- II	-	-
23. *Opuntia ficus-indica*	Cactaceae	IUCN-DD/CITES- II	-	Unknown
24. *Opuntia fuliginosa*	Cactaceae	IUCN-LC/CITES- II	-	Stable
25. *Opuntia jaliscana*	Cactaceae	CITES- II	-	-
26. *Opuntia joconostle*	Cactaceae	CITES- II	-	-
27. *Opuntia pubescens*	Cactaceae	IUCN-LC/CITES- II	-	Stable
28. *Opuntia pumila*	Cactaceae	CITES- II	-	-
29. *Opuntia undulata*	Cactaceae	CITES- II	-	-
30. *Pachycereus pecten-aboriginum*	Cactaceae	IUCN-LC/CITES- II	-	Stable
31. *Pereskia aculeata*	Cactaceae	IUCN-LC	-	Decreasing
32. *Pereskiopsis diguetii*	Cactaceae	IUCN-LC	-	Stable
33. *Pinus devoniana*	Pinaceae	IUCN-LC	-	Stable
34. *Pinus douglasiana*	Pinaceae	IUCN-LC	-	Unknown
35. *Pinus leiophylla*	Pinaceae	IUCN-LC	-	Stable
36. *Pinus lumholtzii*	Pinaceae	IUCN-NT	-	Unknown
37. *Pinus maximinoi*	Pinaceae	IUCN-LC	-	Stable
38. *Pinus oocarpa*	Pinaceae	IUCN-LC	-	Unknown
39. *Prosopis laevigata*	Fabaceae	IUCN-LR	-	-
40. *Quercus castanea*	Fagaceae	IUCN-LC	-	Decreasing
41. *Quercus subspathulata*	Fagaceae	IUCN-VU	-	-
42. *Sagittaria macrophylla*	Alismataceae	NOM (A)	Endemic	-
43. *Selaginella porphyrospora*	Selaginellaceae	NOM (P)	Not Endemic	-
44. *Stenocereus queretaroensis*	Cactaceae	IUCN-LC/CITES- II	-	Stable
45. *Tripsacum maizar*	Poaceae	NOM (A)	Not Endemic	-
46. *Zantedeschia aethiopica*	Araceae	IUCN-LC	-	Unknown

should be taken with caution due to differences in authors' sampling effort and imprecision in the calculation of areas (Table 6).

Land use and Vegetation. The vegetation of the Sayula sub-basin is not a homogeneous mosaic, since it presents different vegetal communities that possess a very peculiar and interesting flora, in addition they are carried out different productive activities like agriculture and the cattle

Table 5. Geographical distribution patterns of the species present in the Sayula sub-watershed

Distribution	Number of species	Percentage
Endemic to Mexico	171	24.9
American	147	21.4
From Mexico to Central America	133	19.4
Cosmopolitan	57	8.3
Neotropical	42	6.1
From USA to Mexico	29	4.2
Pantropical	22	3.2
From Mexico to South America	25	3.6
From USA to Central America	20	2.9
North American	20	2.9
Disjunct	12	1.7
Endemic to the West Mexico	9	1.3
Total	**687**	**100.0**

ranch. Within the zone we can distinguish eight vegetation types according to the classification of Rzedowski (1978) and four variants of land use (Figure 2). The order of the descriptions of the plant communities is based on the area occupied within the sub-basin, showing the percentages of the area covered by each current vegetation type.

Table 6. Relation between the floristic richness of the Sayula sub-basin Jalisco, and other areas of different surface areas that have floristic inventories in Mexico, using the taxonomic biodiversity index (B). APFFLP = Protection Area of Flora and Fauna La Primavera. APH BENSEDI = Area of Hydrological Protection Forest Nixticuil-San Esteban-El Diente. LnA = Natural logarithm of the area in km2. Abbreviations: NR = Not registered. Vegetation Types of according to Rzedowski & McVaugh (1966) and Rzedowski (1978). Abbreviations: OF = Oak Forest; THF = Thorn Forest; RF = Riparian Forest; CF = Cloud forest; PF = Pinus forest; POF = Pine-Oak Forest; OPF = Oak-Pine Forest; TDF= Tropical Deciduous Forest; TSF = Tropical Subdeciduous Forest; D= Desert; G = Grassland; AV = Aquatic Vegetation; HV = Halophytic Vegetation; SV = Secondary Vegetation.

Source	Town	Area (Km^2)	Range Altitudinal(m)	Vegetation types	Explorations Number's	Families	Genera	Species	Richness (Sp/lnA)
Machuca-Núñez 1989	Cerro Viejo	100	1,900-2,300	PF, POF, TDF, G, AV	97	162	511	990	214
Lott 1993	Bahía de Chamela	350	0-500	TDF, TSF, HV	NR	124	544	1,120	191
Guerrero-Nuño & López Coronado, 1997	Sierra de Quila	320	1,300-2,560	THF, TDF, OF, POF, CF, RF	45	128	427	772	134
Villegas-Flores *et al.* 1995	Laguna de Sayula	27	1,300	AV, THF, TDF, RF, SV	NR	76	208	306	93
Fernández-Nava *et al.* 1998	Cuenca del río Balsas	112,320	0-1,000	TDF, OF D	NR	202	1,246	4,442	381
Zepeda & Velázquez 1999	Sierra de Nachichitla	13.2	600-1,400	TDF, RF	15	82	208	288	111
Contreras-Rodríguez *et al*. 2000	Piedras Bolas	-	1,500-2,300	TDF, RF, G, OF	NR	43	99	139	-
Cortes-Romero 2000	Laguna de Cajititlán	74.1	1,500-2,030	TDF THF, AV, SV	46	82	285	469	109
Macías-Rodríguez & Ramírez-Delgadillo 2000	Cerro del Colli	3.5	1,700-1,950	OF, TDF, SV	5	53	132	188	150
SEMARNAT 2000	APFFLP	305	1,800-2,200	TDF, POF, OF, AV	NR	107	419	805	140
Hernández-Toro 2003	Tecolotlán y María García	850	0-929	TSF, TDF, THF, G, OF, AV	250	129	493	1029	152
Wynter-Warra *et. al*. 2003	Cerro Gordo	5.68	2,400-2,600	OF, TDF, RF, SV	NR	64	184	278	160
Ramírez-Delgadillo *et al.* 2006	APH BENSEDI	159	1,550-1,620	TDF, OF, POF, THF, G, SV	NR	77	225	456	90
León de la Luz *et al.* 2012	Península de Baja California	3,325	500-1,500	TDF	12	101	360	645	79
Ramírez–Díaz 2016	Subcuenca Cuixtla, Jalisco-Zacatecas	123	810-1,770	TDF-RF	50	108	373	610	127
This work	Subuenca Sayula	1,476	1,110-2,868	TDF, RF, AV, HV, OPF, OF, THF, POF	-	113	416	686	94

Tropical Deciduous Forest. In the study area the tropical deciduous forest occupies an area of 36,436.05 ha (24.69 %), being the plant community with greater distribution. It develops mainly in the foothills of the slopes of the surrounding Sierras to the lagoon, both in the north and west slopes of Sierra del Tigre, as in the east orientation of Tapalpa and in the southern slope of the Cerro de García and El Caracol; Inside of the lagoon is only found in the central parts of two "islands", (Isla Grande and Isla Chica) on rocky outcrops, since around these they are covered of thorn forest.

The prominent feature of this type of forest is the loss of leaves in almost total form over a period of 5 to 8 months, so it has two strongly contrasting aspects: in drought it is desolate, with gray tones, while in rainy season it is green and vital. The height of the canopy varies from 4-8 (10) m.

The vegetation cover consists of small individuals such as *Bursera fagaroides*, *B. penicillata*, *Ceiba aesculifolia*, *Cnidoscolus spinosus*, *Ipomoea murucoides*, *Lysiloma divaricatum* and candelabriform cacti with *Stenocereus queretaroensis* and *Isolatocereus dumortieri*. In this plant community, several large trees stand out, *Ficus insipida*, *F. goldmanii* and *F. subrotundifolia*, which occur near some outcrop of water (Villegas-Flores *et al*. 1995).

From the point of view of forest use, this type of vegetation is of little importance, because the size and shape of its trees do not have desirable characteristics for trade (Rzedowski 1978). It is used more for livestock purposes, although with scarce yields. The topography and climate does not allow irrigated crops, but when it exists, conditions change completely and the forest becomes important agricultural areas, such as the areas near Zacoalco, Amacueca and Techaluta, where one of the most important crops, such as the "Pitaya" (*Stenocereus queretaroensis*), is established in areas originally occupied by the tropical deciduous forest.

Pine Forest. In the Sayula sub-basin it is distributed mainly in areas with subhumid climates called temperate, corresponding to the highest parts of the sierras that surround the lagoon and Cerro de García, occupies an area of 23,411.26 ha, corresponding to 15.87 % of the surface.

This plant community is formed by species of the genus *Pinus*, often associated with oak and other species, its physiognomy is very characteristic, being a closed community of always green individuals, with acicular leaves, straight trunks that have heights that go from 15 to 20 m on average; In contrast, the undergrowth in the dry season presents a different aspect, almost yellowish, made up of herbaceous grasses predominating. The shrub layer is almost absent, or is hardly apparent.

The most common species that characterize this type of vegetation are: *Pinus devoniana*, *P. douglasiana*, *P. leiophylla*, *P. lumholtzii*, *P. maximinoi* and *P. oocarpa*. These forests are of major economic importance in the area due to their forestry activities such as timber production, resins, pulp production for cellulose and backyard for the villages of Mazamitla and Tapalpa, where there is a great ecotourism activity.

Halophytic Vegetation. It is present only inside the lake bed and surrounding foodplains, and is distributed almost throughout the length and width of the body, in the form of narrow annular stripes and scattered spots within it, is constituted mainly by an herbaceous stratum conformed by a low zacatal constituted for several annual species. It represents almost 4.65 % of the study area, occupying an approximate area of 6,865.32 ha of the sub-basin.

This vegetation is characterized to develop in soils with high content in soluble salts, can assume diverse forms, floristic, physiognomic and ecologically, since they can dominate in them forms herbaceous and shrub. This fact is at least partly due to the fact that edaphic characteristics fluctuate as regards the quantity and type of salts, as well as the pH, texture, permeability, amount of water available, etc.

Among the species that make up this type of vegetation known as "salty pastures" we find *Bouteloua diversispicula*, *Cenchrus ciliaris*, *Distichlis spicata*, *Jouvea pilosa* and *Sporobolus coromandelianus*, as well as other species such as *Suaeda torreyana*, *Scirpus americanus*, *Trianthema portulacastrum* and *Oligomeris linifolia* (Macías-Rodríguez 2004). Often the zacatal is intermixed with spots of thorn forest with *Celtis pallida*, *Opuntia atropes* and *Prosopis laevigata*.

The halophytic vegetation is not of great economic importance due to its characteristics, although the "Romeritos" (*Suaeda torreyana*) grow here, there is very little consumption by the inhabitants of the region. In this area also, the extensive livestock is developed, since the cattle takes advantage of the shoots of the grasses in the early rains, before the hardening of the branches and leaves, since after this time, the buds resemble thorns, which harms the esulting in detrimental results.

Oak Forest. It is distributed mainly in the Sierra de Tapalpa, always below the altitudinal limits of the pine forest, and also bordering the tropical deciduous forest and in some parts with temporary agriculture, covers an area of 5,209.59 ha representing the 3.53 % of the total area.

Along with pine forests, oak forests represent another type of temperate major vegetation in the area, Mexico being the largest center of wealth and specific endemism for the genus *Quercus* (Valencia 2004); It shares space with different species of pine (*Pinus* spp.), Giving rise to the so-called pine-oak forests, or oak-pine forests, when they dominate the oak forests.

The most common species of these communities are *Quercus candicans*, *Q. castanea*, *Q. crassipes*, *Q. gentryi*, *Q. magnoliifolia*, *Q. resinosa* and some other species that intermingle with ecotonies of tropical deciduous forest, such as *Bursera fagaroides*, *Eysenhardtia polystachya*, *Ipomoea murucoides* and *Lysiloma acapulcense*.

These forests have been heavily exploited for logging purposes for the extraction of wood, for the production of charcoal and boards for domestic use, which causes this vegetation type to reach secondary phases, which are later incorporated into agricultural activities.

Oak-Pine Forest. It appears as a spot in the study area, to the east, between the Cerro de García and the northern orientation of the Sierra del Tigre below the communities of pine forest, while in the western orientation of the Sierra, Is intermingled with tropical deciduous forest and seasonal agriculture areas, with a lower proportion also found in the Sierra de Tapalpa, northwest of Usmajac; Covers an area of 5,015.74 ha, which corresponds to 3.4 % of the total of the region.

This community is characterized mainly by the dominance of oaks on the pines. It develops below the altitudinal limits of pine, oak-pine and above the tropical deciduous forest. These communities show a lower height than those where the pine dominates over the oak.

The most representative trees species in these communities are: *Clethra hartwegii*, *Pinus devoniana*, *P. leiophylla*, *P. oocarpa*, *Quercus candicans*, *Q. castanea*, *Q. crassipes*, and *Q. magnoliifolia*. Like the pine-oak communities, these also present forest use, in addition, in many areas there is an alternation with agricultural activities. Due to activities such as clearing for pine extraction, some oak forests obey their physiognomy and structure more than anything to the competition factor, where the oaks predominate over the pines; being also evident the presence of *Dodonaea viscosa* in the manner of dense patches, which is indicative stages successions of disturbed forests.

Thorn Forest. It includes a plant community whose common denominator is its rather reduced height and the fact that at least to a large extent are thorny individuals, with perennial leaves, characteristic of flat or slightly sloping land, soils are clayey, pH slightly alkaline, poorly drained and often flooded periodically. It often develops in places with drier climates than tropical deciduous forest, but occupies deeper soils (Rzedowski 1978).

Thorny elements abound, where the Fabaceae family is the most abundant. Among the numerous prickly plants, there are also often cactaceae in the shape of a candelabra that protrude from the arboreal canopy. The species constituting this plant community are mainly *Opuntia atropes*, *O. fuliginosa*, *Prosopis laevigata*, and less frequently *Pithecellobium dulce*. They dominate thin trees, with small leaves or leaflets, deciduous in the vast majority of cases for variable periods of time. The species *Prosopis laevigata* is dominant in the arboreal stratum (Villegas-Flores *et al*. 1995). The shrub stratus is generally well developed and rich in spiny species such as *Acacia farnesiana*, *Celtis pallida*, *Opuntia pubescens*, *Neurolaena lobata*, *Pereskiopsis diguetii* and *Solanum torvum*.

In the region, the Thorn Forest is estimated at about 2.15 % of the territory (3,169.96 ha). Such lands are and have been the most used for agriculture and livestock, consequently, what

is left of the thorn forest, are only relict or small patches around the lagoon, intermixing with halophytic vegetation, tolerating the basic soils and in some occasions these lands are flooded in the rainy season, when the water level rises. The area occupied by this community tends to diminish its extension in the lagoon, due to the clearing for the establishment of crops, whether of irrigation or of temporary.

Pine-Oak Forest. This community, like pine-oak forests, are also called mixed forests, are considered transitional phases of pure pine or oak forests, however, some authors claim that many of these forests are considered the climax vegetation of many Temperate zones, which is shared by the different species of *Pinus* and *Quercus*; Being dominant the pines on the oaks.

This type of forest is the least distributed arboreal community, occupying only 0.27 % of the study area, corresponding to 404.77 ha; is distributed only to the east and southeast of the towns of Tepec and San Antonio, in the eastern slope of the Sierra de Tapalpa. Some of the most common pine species are *Pinus devoniana*, *P. leiophylla*, *P. oocarpa*, *Quercus candicans*, *Q. crassifolia* and *Q. crassipes*.

Aquatic Vegetation. It is called aquatic vegetation to all those vegetal groupings that develop in an aqueous medium or in soils saturated of water; Together constitute an important part of the vegetation of the sub-basin. This plant community is distributed within the study area, as small patches, occupying a 0.07 % with 96.41 ha, located towards the central part of the lagoon. The species that constitute it are grouped in dense masses that sometimes cover important surfaces of the lacustrine area, to borders of ditches, channels of irrigation and streams; its physiognomy is mainly given by monocotyledons from one to three meters high and narrow leaves. In this type of vegetation we can distinguish broadly three main associations: tular and carrizal, floating vegetation and underwater vegetation.

Irrigation Agriculture. In this type of agriculture, it uses supplementary water systems to obtain crops during the agricultural cycle, and can be of different variants depending on how the application of the water is carried out, for example sprinkling, dripping, or distribution of water along furrows or a pipe starting from a main channel which is distributed directly to the crop by pumping from the source of supply (a well, dam or body of water) or by gravity action when it goes directly to a main channel from upstream.

This type of agrosystem occurs in most of the territory, mainly in the plains areas, mainly in the southern portion of the lagoon, and in the Teocuitatlán de Corona plain, between the southern slopes of the Cerro de García and El Caracol and the north face of the Sierra del Tigre. It occupies the second place (18.71 %) of distribution in the study area, with an approximate area of 27 609.14 ha. The main crops in the area are maize for the production of seeds, alfalfa and vegetables mainly tomato and red pepper.

Temporary Agriculture. It is called temporary agriculture the type of activity that takes place in all those lands where the cycle of crops that are planted depends on rainwater; So the success of the harvest depends on the amount of water that falls and the ability of the soil to retain it.

Within the study area, it is presented in the form of manchones, distributed throughout the area, but mainly near the populations, it covers a greater area in the western and eastern part of the Sierra del Tigre, and considerable portions the Sierra de Tapalpa in the villages of Techaluta and Amacueca; and occupies 18.51 % of the total area (27,307.52 ha). They can be areas of monoculture or polyculture and can be combined with secondary pastures, mixed with irrigation areas, or in areas that clear the deciduous tropical forest called cuamiles; which forms a complex mosaic, difficult to distinguish or separate, but which generally presents dominance of crops whose growth depends on rainwater.

The main crops are maize and sorghum but there are also cultivated areas of pitaya (*Stenocereus queretaroensis*) and zacate rhodex (*Chloris gayana*).

Livestock. It is denominated with the term of farming to all those areas where the human activity is oriented so much to the culture of the field as to the raising of animals. Generally they

Table 7. Area and percentage of each type of vegetation and land use recorded in the Sayula sub-basin, Jalisco, Mexico. ha = hectares; % = percentage.

Vegetation type	ha	%
Tropical Deciduous Forest	36 436.05	24.69
Pine Forest	23 411.26	15.87
Halophytic Vegetation	6 865.32	4.65
Oak Forest	5 209.59	3.53
Oak-Pine Forest	5 015.74	3.40
Thorn Forest	3 169.96	2.15
Pine-Oak Forest	404.77	0.27
Aquatic Vegetation	96.41	0.07
Land Use		
Irrigation Agriculture	27 609.14	18.71
Temporary Agriculture	27 307.52	18.51
Areas without vegetation	6 815.58	4.62
Population	2 412.41	1.63
Communication Paths	1 319.22	0.89
Livestock	939.81	0.64
Lagoon	544.52	0.37
Total	**147 557.29**	**100**

are areas devoid of vegetation, or this is in some phase of its process of succession, which are denominated matorraleras, cuamiles, or secondary vegetation.

These areas are mainly made up of shrub and herbaceous species, which do not pass more than 1.5 m high, their coverage is often poor, but in advanced stages of the process of succession can be very closed communities. The main species that form it are *Acacia farnesiana*, *A. pennatula*, *Argemone ochroleuca*, *Datura stramonium*, *Nicotiana glauca*, *Solanum ferrugineum*, *Ricinus communis*, *Wigandia urens*, and a great number of grasses and composites among which we can mention *Cenchrus echinatus*, *Chloris gayana*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Eleusine indica*, *Melinis repens* and *Paspalum notatum* among grasses and *Baccharis salicifolia*, *Bidens aequisquama*, *Melampodium divaricatum*, *Stevia serrata*, *Tagetes filifolia* and *Verbesina fastigiata*, within Asteraceae.

It is present throughout the study area, mainly near the populations and intermixing with tropical deciduous forest, oak forest and seasonal agricultural areas, on the eastern slope of the Sierra de Tapalpa and on the north face of the Sierra del Tigre. Occupies an area of 4,939.81 ha, which represents 0.64 %. Both activities, both agriculture and livestock, are closely linked as they benefit each other. The cattle provide manure, which is used as fertilizer for pastures and crops and these serve to feed the animals.

Areas with no apparent vegetation. Corresponds to all areas that are devoid of vegetation such as bodies of water, populations and existing infrastructure, and therefore can not be included under any of the types of vegetation mentioned above, and corresponds to 4.62 % with a surface occupation of 6,815.58 ha (Table 7).

Discussion

Floristic diversity. The diversity of the flora in the study area is the result of the great heterogeneity of environments that allow the development of a variety of plant communities, each of which offers special conditions for the development of different species.

Within the vascular flora of the Sayula sub-basin is represented 3 % of vascular plants, 14.54 % of the genera and 38 % of the families for Mexico (Villaseñor 2016). In only 1.84 % of the state territory is represented 48 % of families of the 235, 27 % of the genera of 415 and 9.6 % of the 7,155 species reported by Villaseñor (2016) for the State.

The main families recorded Poaceae, Asteraceae, Fabaceae, Solanaceae and Euphorbiaceae coincide equally with the 15 most diverse families of Mexico, results that are ratified with the present study.

Similarly, the five most diverse genera such as *Solanum*, *Euphorbia*, *Quercus*, *Ipomoea*, *Salvia*, are also the most numerous and widely distributed in the country (Villaseñor 2016). This is corroborated by the different floristic works carried out in different regions of the country (Cabrera-Luna & Gómez-Sánchez 2005, Frías-Castro *et al*. 2013, Morales-Saldaña *et al*. 2015 and Morales-Arias *et al*. 2016).

In Jalisco, the genus *Solanum* has the highest number of species within this family, and it should be noted that in this area of study 21 species were recorded, corresponding to 38 % of the 55 species reported for Jalisco (Cuevas-Arias *et al*. 2008). The dominance of this genus may be due to the fact that, like many other Solanaceae, they are favored by disturbed ecological conditions preferring degraded or rudimentary areas (Cuevas-Arias *op cit*.); Others prefer very specific ecological habitats, such as *Lycium carolinianum*, which grows exclusively around salt lakes and periodically flooded, collected around the Laguna de Sayula.

Villegas-Flores *et al*. (1995) reported in the area the presence of *Cirsium horridulum* Michx. var. *horridulum* and *Ledenbergia macrantha* Standl., with this study expanding the distribution of the two species. The first one was previously known of the type locality, in the Villa Corona lagoon (McVaugh 1984). And the second had only been reported from localities in the states of Colima, Veracruz and the southern portion of Jalisco in the Atenquique gorge (Oliva & Ramón 1992).

Biological forms. Herbs and shrubs were the dominant biological forms, coinciding with many floristic works carried out in Mexico (Villegas-Flores *et al*. 1995, Guerrero-Nuño & López Coronado 1997, Fernández-Nava *et al*. 1998, Contreras-Rodríguez *et al*. 2000, Hernández-Toro 2003, Villaseñor 2004, Cabrera-Luna & Gómez-Sánchez 2005, León de la Luz *et al*. 2012, Frías-Castro 2013, Villaseñor & Ortíz 2014 and Morales-Saldaña *et al*. 2015. It was also observed a great correspondence between biological forms and vegetation types in the same way that Cabrera-Luna & Goméz-Sánchez (2005) mention as grasses and shrubs grow in the thorny forest, halophytic grassland and vegetation while trees and shrubs do so in tropical deciduous forest and oak-pine forest.

The great diversity of biological forms found in the study area could be due to the great environmental heterogeneity, as well as to the presence of eight different types of vegetation from the thorn forest of semiarid climate to the aquatic vegetation. The diversity of species and life forms recorded coincides with that reported by Rzedowski (1998), who mentions that the flora of Mexico is rich in species numbers and is also diverse in biological forms, especially in arid and semiarid vegetation.

Species under some category of protection. Only five species included in the NOM-059 were recorded, 18 species in CITES II and 24 species in IUCN (2015). Although the information for protected species, the population status is stable, in many of them it is unknown (Table 4). It was found a report of a new species for the zone according to Villegas-Flores & Ramírez-Delgadillo (1998) *Cleomella jaliscensis*, for the moment the species is only known of this region, it develops in thorny forest with halophytic vegetation at 1,300 m asl (Figure 3). Is in danger of disappearing since the area where it is developed is subject to grazing. And the most worrying thing is that it is not on any national or international list as a species to be protected. Therefore it is suggested to implement studies on population ecology for some species (*Mammillaria scrippsiana*, *Cleomella jaliscensis*, *Begonia* spp., *Hylocereus* spp. and *Sedum* spp.) (Figure 4). Since many of these are still extracted from their natural habitat for sale, others are destroyed by the change of land use, due to the fact that the area is under temporary agriculture and irrigation, mainly those areas of thorny forest that are surrounding the lagoon and those species that develop in the tropical deciduous forest, to have a more objective assessment and include them in the corresponding categories.

Geographic distribution. In only three distribution patterns (endemic, American and from Mexico to Central America), 65.8 % of the recorded flora is housed. It should be noted that of the total number of species registered, only 25 % are endemic to Mexico and 1.3 % are endemic to the west of the country, remaining well below that suggested by Villaseñor (2016), which is 49.8 %

Figure 3. Some of the vascular plants present in the Sayula sub-basin. Part I. 1) *Isolatocereus dumortieri*; 2) *Cleomella jaliscensis*; 3) *Sedum jaliscanum*; 4) *Bursera bipinnata*; 5) *Opuntia pubescens*; 6) *Arctostaphylos pungens*.

Figure 4. Some of the vascular plants present in the Sayula sub-basin. Part II. 7) *Polypodium madrense*; 8) *Cheilanthes kaulfussii*; 9) *Bursera penicillata*; 10) *Sedum greggii*; 11) *Agave inaequidens*; 12) *Salvia mexicana*; 13) *Stenocereus queretaroensis*.

for the national flora. This is probably explained by the fact that in the study area, much of the natural vegetation has been replaced by large areas of agriculture, both irrigation and rainfall, which leads to the loss of native biodiversity, which has been replaced by species of cosmopolitan, pantropical or neotropical distribution, benefited by these anthropogenic activities.

Floristic Richness. One of the main reasons that the Sayula sub-basin has registered fewer species/km^2 compared to other sites may be due to the anthropic degradation suffered by the region, as mentioned above, large areas for irrigation and temporary agriculture, as both areas make up 37 % of the region, in addition to livestock activity. Due to the great agricultural activity that occurs in the region, in 1978 an intermediate and partial closure was decreed for the extraction of groundwater in the southern part of the lagoon, it was recommended not to increase the exploitation for agricultural purposes and to reserve this area to satisfy future demands of drinking water for the population (Ávila 1994).

Vegetation and land use. This study is a contribution to knowledge of the flora and vegetation of Jalisco, taking into account that only 60 % of the State has been explored (Ramírez-Delgadillo *et al*. 2010), because there are many areas to explore and many species to be discovered; in addition this floristic information is complemented with a map of current vegetation and the use of soil that develops within the region.

The Sayula sub-basin is crossed by the highway Guadalajara-Colima, which brings as a consequence a great disturbance, mainly in the neighboring plant communities such as aquatic vegetation, thorn forest and halophytic vegetation. The latter being of great importance to waterfowl, both migratory and resident, as it maintains large populations migrating from Alaska, Canada and the USA. During the winter season, as the "Canadian goose" (*Chen caerulescens*) "freshwater seamstress" (*Limnodromus scolopaceus*), "western playerito" (*Calidris mauri*) among others, which feed on different salty grasses such as *Distichlis spicata*, *Eragrostis obtusiflora* and *Sporobolus pyramidatus*. Because this type of vegetation provides shelter, food and protection to these wild species, has been declared a priority area for conservation and has been declared RAMSAR site since 2004.

Based on what has been observed in the field during the years that have been worked in the sub-basin, it is necessary to publicize the problems that affect these vegetable communities and that have an impact on them, since some activities have been detected that break the natural balance of the region, such as garbage dumps, sewage dumps to the lagoon.

On the other hand, agricultural use and extensive livestock tend to reduce natural areas and modify the landscape, which leads to the disappearance of native species and the establishment of invasive species. Other species, on the other hand, are favored by anthropogenic activities such as fires, breach openings, land use change, such as the *Cuscuta* spp., *Heliotropium curassavicum*, "mistletoe" *Phoradendron* spp., *Psittacanthus calyculatus*, *Salsola kali* and *Verbesina encelioides*, whose populations have to increase and spread to other communities.

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Appendix 1. Vascular flora of the Sayula sub-basin, Jalisco, Mexico. The floristic cheklist is presented in alfabetical order by family, genera and species and is divided into the following groups: Lycophyta, Monilophyta, Pinophyta and Magnoliophyta, divided in turn into Complex Magnoliide, Eudicots and Monocotyledons. **Biological Form:** C= Cane; H= Herb; L= Liana. R= Rosette; S= Shrub; Sf= Suffrutext; Su= Succulent; T= Tree; V= Vine. **Habitat:** A= Aquatic; E= Epiphyte; Pa= Parasite; R= Rupicolous; T= Terrestrial. **Introduced/Native:** I=Introduced; N= Native; Af= Africa; As= Asia; Au= Australia; Ea= Euroasia; Eu= Europe; In= India; Sa=South America; Sf= South Africa. Distribution: AME= American; COS=Cosmopolitan; DIS= Disjunct; END-MEX= Endemic to Mexico; END-WEST= Endemic to West Mexico;MEX-CEAM= From Mexico to Central America; MEX-SOAM= From Mexico to South America; NEO= Neotropical; NOA= North American;PAN= Pantropical; USA-CEAM= From USA to Central America; USA-MEX= From USA to Mexico. **Vegetation Type:** AV= Aquatic Vegetation; HV= Halophytic Vegeteation; OF= Oak Forest; OPF= Oak-Pine Forest; PF=Pine Forest; POF= Pine-Oak Forest; TDF= Tropical Deciduous Forest; THF= Thorn Forest. *Weed.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Lycophyta					
Selaginellaceae					
Selaginella porphyrospora A.Braun	H	T	N	MEX-CEAM	TDF, THF, POF
Monilophyta					
Aspleniaceae					
Asplenium monanthes L.	H	T	N	COS	POF
Athyriaceae					
Woodsia mollis (Kaulf.) J.Sm.	H	R	N	MEX-CEAM	OF, POF, PF, POF
Blechnaceae					
Blechnum occidentale L.	H	T	N	NEO	TDF, OF
Woodwardia spinulosa M.Martens & Galeotti	H	T	N	MEX-CEAM	TDF, OF
Dennstaedtiaceae					
Pteridium caudatum (L.)Maxon	H	T	N	NEO	OF, POF, PF, POF
Dryopteridaceae					
Dryopteris cinnamomea (Cav.) C.Chr.	H	R	N	END-MEX	OF, POF, PF, POF
Elaphoglossum muelleri (E. Fourn.) C.Chr.	H	R	N	MEX-CEAM	OF, POF, PF, POF
Ophioglossaceae					
Ophioglossum engelmannii Prantl	H	T	N	MEX-CEAM	TDF, OF
Polypodiaceae					
Pleopeltis mexicana (Fée) Mickel & Beitel	H	E	N	MEX-CEAM	OF, PF
Polypodium madrense J.Sm.	H	E	N	END-MEX	TDF
Pteridaceae					
Adiantum andicola Liebm.	H	T	N	MEX-CEAM	TDF, OF
Astrolepis sinuata (Lag. ex Sw.) D.M. Benham & Windham	H	R	N	NEO	TDF
Bommeria pedata (Sw.) E. Fourn.	H	R	N	MEX-CEAM	TDF, OF
Cheilanthes angustifolia Kunth	H	T	N	MEX-CEAM	POF
Cheilanthes arizonica (Maxon)Mickel	H	R	N	NOA	TDF, THF, POF
Cheilanthes farinosa (Forssk.)Kaulf.	H	T	N	PAN	POF
Cheilanthes kaulfussii Kunze	H	T	N	MEX-CEAM	TDF
Cheilanthes lozanoi (Maxon) R.M. Tryon & A.F. Tryon	H	R	N	END-MEX	OF, POF, PF, POF
Pellaea oaxacana Mickel & Beitel	H	R	N	END-MEX	TDF, THF, POF
Pellaea ternifolia (Cav.)Link.	H	T	N	NEO	POF
Pteris cretica L.	H	R	N	PAN	OF, POF, PF, POF
Schizaeaceae					
Anemia hirsuta (L.) Sw.	H	T	N	NEO	TDF, OF
Thelypteridaceae					
Thelypteris pilosa (M. Martens & Galeotti) Crawford	H	T	N	MEX-CEAM	POF, PF
Pinophyta					
Cupressaceae					
Callitropsis lusitanica (Mill.)D.P. Little	T	T	N	MEX-CEAM	OF, POF, PF, POF
Pinaceae					
Pinus devoniana Lindl.	T	T	N	MEX-CEAM	OF, POF, PF, POF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Pinus douglasiana Martínez	T	T	N	END-MEX	OF, POF, PF, POF
Pinus leiophylla Schiede ex Schltdl. & Cham.	T	T	N	END-MEX	OF, POF, PF, POF
Pinus lumholtzii B.L. Rob. & Fernald	T	T	N	END-MEX	OF, POF, PF, POF
Pinus maximinoi H.E. Moore	T	T	N	MEX-CEAM	OF, POF, PF, POF
Pinus oocarpa Schiede	T	T	N	MEX-CEAM	OF, POF, PF, POF
Magnoliophyta					
Complejo Magnoliide					
Annonaceae					
Annona longiflora S. Watson	T	T	N	END-MEX	TDF
Aristolochiaceae					
Aristolochia foetida Kunth	V	T	N	END-MEX	TDF, THF
Ceratophyllaceae					
* *Ceratophyllum demersum* L.	H	A	N	COS	AV
Hernandiaceae					
Gyrocarpus jatrophifolius Domin	T	T	N	MEX-CEAM	TDF
Piperaceae					
Peperomia galioides Kunth	H	T	N	MEX-SOAM	OF, POF, PF, POF
Eudicotiledóneas					
Acanthaceae					
* *Aphelandra* sp.	S	T	N	MEX-SOAM	TDF
* *Blechum pyramidatum* (Lam.) Urb.	H	T	N	AME	TDF
Carlowrightia arizonica A.Gray	H	T	N	MEX-CEAM	TDF
* *Dicliptera peduncularis* Nees	H	T	N	USA-MEX	TDF
Dyschoriste angustifolia (Hemsl.) Kuntze	H	T	N	END-MEX	TDF
* *Elytraria imbricata* (VahlPers.	H	T	N	AME	TDF, OF
Ruellia bourgaei Hemsl.	H	T	N	END-MEX	TDF
Ruellia lactea Cav.	H	T	N	MEX-CEAM	TDF
TetrAmerium nervosum Nees	Sf	T	N	AME	TDF
Aizoaceae					
* *Sesuvium portulacastrum* (L.) L.	H	T	N	AME	TDF, HV
* *Trianthema portulacastrum* L.	H	T	N	PAN	TDF
Amaranthaceae					
* *Achyranthes aspera* L.	H	T	N	PAN	TDF, THF
* *Amaranthus hybridus* L.	H	T	N	AME	TDF
* *Amaranthus spinosus* L.	H	T	N	COS	TDF
* *Atriplex linifolia* Humb. & Bonpl. exWilld.	S	T	N	END-MEX	TDF
* *Atriplex semibaccata* R.Br.	S	T	I (Au)	COS	TDF
* *Chenopodium album* L.	H	T	I (Ea)	COS	TDF
* *Chenopodium ambrosioides* L.	H	T	N	AME	TDF, THF
* *Chenopodium mexicanum* Moq.	H	T	N	END-MEX	TDF, THF
* *Gomphrena nitida* Rothr.	H	T	N	USA-MEX	TDF, THF
Gomphrena serrata L.	H	T	N	AME	TDF, THF
Iresine calea (Ibantz) Standl.	V	T	N	AME	TDF
Iresine interrupta Benth.	V	T	N	MEX-CEAM	TDF
* *Suaeda torreyana* S.Watson	Sf	T	N	NOA	OF, POF, HV
Anacardiaceae					
Amphipterygium adstringens (Schltdl.)Standl.	T	T	N	END-MEX	TDF
Anacardiaceae					
Rhus trilobata Nutt.	S	T	N	NOA	OF, POF, PF, POF
* *Toxicodendron radicans* (L.)Kuntze	L	T	N	DIS	PF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Apiaceae					
Berula erecta (Huds.) Coville	H	T	N	NOA	OF, POF, PF, POF
* *Daucus montanus* Humb. & Bonpl. ex Schult.	H	T	N	AME	OF
Donnellsmithia mexicana (B.L. Rob.) Mathias & Constance	H	T	N	END-MEX	OF, POF, PF, POF
Eryngium beecheyanum Hook. f. & Arn.	H	T	N	MEX-CEAM	TDF, THF, POF
* *Eryngium bonplandii* F. Delaroche	H	T	N	END-MEX	TDF, THF, POF
Micropleura renifolia Lag.	H	T	N	MEX-CEAM	TDF, THF
* *Spananthe paniculata* Jacq.	H	T	N	NEO	OF, POF, PF, POF
Apocynaceae					
* *Asclepias curassavica* L.	H	T	N	PAN	TDF, THF, POF
Cryptostegia grandiflora Roxb.ex R.Br.	S	T	I (Sa)	AME	HV
Funastrum pannosum Schltr.	V	T	N	END-MEX	TDF
Gonolobus erianthus Decne.	V	T	N	MEX-CEAM	TDF
Orthosia guilleminiana (Decne.)Liede & Meve	V	T	I (Sa)	AME	TDF
Plumeria rubra L.	T	T	N	MEX-CEAM	TDF
Tabernaemontana tomentosa (Greenm.) A.O.Simões & M.E.Endress	S	T	N	END-MEX	TDF
Thevetia ovata (Cav.) A. DC.	T	T	N	MEX-CEAM	TDF
Araliaceae					
Hydrocotyle verticillata Thunb.	H	A	N	AME	AV
Oreopanax xalapensis (Kunth) Decne. & Planch.	T	T	N	MEX-CEAM	TDF
Asteraceae					
Acourtia dugesii (A.Gray) Reveal & R.M.King	H	T	N	END-MEX	OF
Acourtia wislizeni var. *megacephala* (A.Gray) Reveal & R.M. King	H	T	N	END-MEX	OF
* *Ageratum corymbosum* Zucc. ex Pers.	Sf	T	N	MEX-CEAM	OF
* *Ageratum houstonianum* Mill.	H	T	N	MEX-CEAM	OF, POF, PF, POF
* *Ambrosia confertiflora* DC.	H	T	N	AME	TDF
* *Baccharis salicifolia* (Ruiz & Pav.) Pers.	S	T	N	AME	TDF, THF
* *Barkleyanthus salicifolius* (Kunth) H.Rob. & Brettell	S	T	N	AME	TDF, THF, POF
Bidens aequisquama (Fernald) Sherff	H	T	N	END-MEX	OF, POF, PF, POF
* *Bidens laevis* (L.) Britton, Sterns & Poggenb.	H	T	N	AME	OF
Bidens lemmonii A.Gray	H	T	N	USA-MEX	OF, POF, PF, POF
* *Bidens reptans* (L.) G.Don	H	T	N	AME	THF
* *Calyptocarpus vialis* Less.	H	T	N	USA-MEX	TDF, THF
Chromolaena collina (DC.)R.M. King & H. Rob.	S	T	N	MEX-CEAM	OF, POF, PF, POF
* *Cirsium horridulum* Michx.	H	T	N	USA-CEAM	POF, AV
Conoclinium betonicifolium (Mill.)R.M. King & H. Rob.	H	T	N	MEX-CEAM	OF, POF, PF, POF
* *Conyza coronopifolia* Kunth	H	T	N	MEX-SOAM	PF, POF
Cosmos carvifolius Benth.	H	T	N	END-MEX	THF, OF, POF, PF, POF
Dahlia coccinea Cav.	H	T	N	MEX-CEAM	TDF, THF, POF
* *Delilia biflora* (L.)Kuntze	H	T	N	MEX-SOAM	TDF, THF, POF
Dyssodia cancellata (Cass.) A. Gray	H	T	N	END-MEX	TDF
* *Dyssodia tagetiflora* Lag.	H	T	N	END-MEX	TDF
* *Eclipta prostrata* (L.)L.	H	A	N	COS	TDF
* *Erigeron velutipes* Hook. & Arn.	H	T	N	USA-MEX	PF
* *Flaveria trinervia* (Spreng.)C. Mohr	H	T	N	AME	TDF
* *Florestina pedata* (Cav.)Cass.	S	T	N	MEX-CEAM	TDF
* *Galeana pratensis* (Kunth) Rydb.	H	T	N	MEX-CEAM	TDF
* *Galinsoga parviflora* Cav.	H	T	N	COS	OF
* *Gamochaeta sphacelata* (Kunth)Cab	H	T	N	DIS	HV
* *Heliopsis buphthalmoides* (Jacq.)Dunal	H	A	N	MEX-SOAM	TDF
* *Heterosperma pinnatum* Cav.	H	T	N	USA-CEAM	OF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Hieracium pringlei A.Gray	H	T	N	USA-CEAM	POF
Hofmeisteria schaffneri (A.Gray) R.M.King & H.Rob.	S	T	N	END-MEX	POF
Iostephane heterophylla (Cav.)Benth.	H	T	N	END-MEX	POF
Jaegeria sterilis McVaugh	H	T	N	END-MEX	PF
* *Lagascea decipiens* Hemsl.	S	T	N	USA-MEX	TDF
* *Melampodium americanum* L.	H	T	N	MEX-CEAM	TDF, THF
* *Melampodium divaricatum* (Rich.)DC.	H	T	N	MEX-CEAM	PF
Melampodium nutans Stuessy	H	T	N	END-MEX	TDF, THF
* *Melampodium paniculatum* Gardner	H	T	N	MEX-SOAM	TDF, THF
* *Melampodium sericeum* Lag.	H	T	N	MEX-CEAM	TDF, THF
* *Milleria quinqueflora* L.	H	T	N	MEX-SOAM	TDF, THF
* *Montanoa bipinnatifida* (Kunth)K. Koch	S	T	N	END-MEX	TDF, POF
* *Montanoa tomentosa* Cerv.	S	T	N	USA-MEX	TDF, POF
* *Neurolaena lobata* (L.)R.Br. ex Cass.	S	T	N	AME	THF, TDF, POF
* *Parthenium bipinnatifidum* (Ortega)Rollins	H	T	N	END-MEX	TDF
* *Parthenium hysterophorus* L.	H	T	N	MEX-SOAM	TDF
* *Pectis prostrata* Cav.	H	T	N	AME	TDF, POF
Piptothrix areolare (DC.)R.M. King & H. Rob.	S	T	N	MEX-CEAM	TDF, POF
* *Podachaenium eminens* (Lag.)Sch. Bip.	T	T	N	MEX-CEAM	TDF, POF
* *Porophyllum ruderale* var. *macrocephalum* (DC.) Cronquist	H	T	N	AME	TDF
Psacalium eriocarpum (S.F. Blake)S.F. Blake	H	T	N	END-WEST	OF, POF, PF, POF
* *Pseudelephantopus spicatus* (B. Juss. ex Aubl.) C.F. Baker	H	T	N	AME	TDF
* *Pseudoconyza viscosa* (Mill.)D'Arcy	H	T	N	COS	TDF
* *Pseudognaphalium stramineum* (Kunth)Anderb.	H	T	N	USA-CEAM	HV, PF, OF
Roldana albonervia (Greenm.)H. Rob. & Brettell	S	T	N	END-MEX	TDF
* *Roldana heracleifolia* (Hemsl.)H. Rob. & Brettell	H	T	N	END-MEX	TDF
* *Schkuhria pinnata* (Lam.)Kuntze ex Thell.	H	T	N	AME	OF
Senecio mexicanus McVaugh	H	T	N	END-MEX	OF, PF
* *Simsia amplexicaulis* (Cav.)Pers.	H	T	N	MEX-CEAM	TDF, POF
* *Simsia foetida* (Cav.)S.F. Blake	H	T	N	MEX-CEAM	TDF, POF
* *Simsia lagascaeformis* DC.	H	T	N	USA-CEAM	TDF
* *Sonchus oleraceus* L.	H	T	I (Eu)	COS	TDF, THF
* *Stevia ovata* Willd.	H	T	N	USA-CEAM	TDF, POF
* *Stevia serrata* Cav.	H	T	N	AME	TDF, POF
Symphyotrichum subulatum (Michx.)G.L. Nesom	H	T	N	AME	AV
* *Tagetes erecta* L.	H	T	N	AME	OF, POF, PF, POF
* *Tagetes filifolia* Lag.	H	T	N	MEX-SOAM	TDF, POF
* *Tagetes lunulata* Ortega	H	T	N	MEX-CEAM	TDF, POF
* *Tithonia tubiformis* (Jacq.)Cass.	H	T	N	MEX-CEAM	TDF, THF
* *Tridax coronopifolia* (Kunth)Hemsl.	S	T	N	END-MEX	TDF
* *Trixis mexicana* var. *mexicana* Lex.	Sf	T	N	END-MEX	PF
* *Verbesina fastigiata* B.L. Rob. & Greenm.	S	T	N	END-MEX	TDF, POF
Verbesina grayii (Sch. Bip.)Benth. ex Hemsl.	S	T	N	END-MEX	TDF
Verbesina klattii B.L. Rob. & Greenm.	H	T	N	END-MEX	TDF, POF
* *Verbesina sphaerocephala* A. Gray	S	T	N	END-MEX	TDF, POF
* *Vernonia alamanii* DC.	S	T	N	END-MEX	TDF
Viguiera flava (Hemsl.) S.F. Blake	H	T	N	END-MEX	TDF
* *Xanthium strumarium* L.	S	T	N	NOA	TDF
* *Zinnia Americana* (Mill.)Olorode & A.M. Torres	H	T	N	AME	TDF, THF
* *Zinnia peruviana* (L.) L.	H	T	I (Sa)	AME	TDF, THF
Basellaceae					
Anredera vesicaria (Lam.)C.F. Gaertn.	H	T	N	AME	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Begoniaceae					
Begonia balmisiana Ruiz ex Klotzsch	H	T	N	END-MEX	TDF, POF
Begonia gracilis Kunth	H	T	N	END-MEX	TDF, POF
Betulaceae					
Alnus acuminata Kunth	T	T	N	MEX-CEAM	TDF
Alnus jorullensis Kunth	T	T	N	MEX-CEAM	POF
Bignoniaceae					
* *Tecoma stans* (L.) Juss. ex Kunth	S	T	N	NEO	TDF
Bixaceae					
Cochlospermum vitifolium (Willd.) Spreng.	T	T	N	NEO	TDF
Boraginaceae					
Bourreria sp.	S	T	N	NEO	TDF
Ehretia latifolia Loisel. ex A. DC.	T	T	N	MEX-CEAM	TDF
* *Heliotropium angiospermum* Murray	Sf	T	N	AME	TDF
* *Heliotropium curassavicum* L.	H	T	N	AME	TDF
* *Heliotropium indicum* L.	H	T	N	COS	TDF, THF
* *Lithospermum* sp.	H	T	N	AME	PF, OF
* *Nama jamaicensis* L.	H	T	N	AME	TDF
* *Nama undulatum* Kunth	H	T	N	DIS	TDF
Oncaglossum pringlei (Greenm.) Sutorý	H	T	N	END-MEX	TDF
* *Tournefortia mutabilis* Vent.	S	T	N	MEX-CEAM	TDF
Tournefortia volubilis L.	L	T	N	NEO	TDF
* *Wigandia urens* (Ruiz & Pav.) Kunth	S	T	N	MEX-SOAM	THF
Brassicaceae					
* *Brassica rapa* L.	H	T	N	COS	TDF, THF
* *Lepidium draba* L.	H	T	I (Ea)	COS	TDF, POF
Lepidium graminifolium L.	H	T	N	COS	TDF
* *Lepidium virginicum* L.	H	T	N	COS	TDF
Sinapis alba L.	H	T	I (Ea)	COS	TDF, THF
Burseraceae					
Bursera bipinnata (Moc. & Sessé ex DC.) Engl.	T	T	N	MEX-CEAM	TDF, POF
Bursera copallifera (Sessé & Moc. ex DC.) Bullock	T	T	N	END-MEX	TDF
Bursera fagaroides (Kunth) Engl.	T	T	N	END-MEX	TDF, POF
Bursera palmeri S. Watson	T	T	N	END-MEX	TDF
Bursera penicillata (Sessé & Moc. ex DC.)Engl.	T	T	N	END-MEX	TDF, POF
Bursera roseana Rzed., Calderón & Medina	T	T	N	END-MEX	TDF
Cactaceae					
Hylocereus purpusii (Weing.)Britton & Rose	Su	E	N	END-MEX	TDF, POF
Hylocereus undatus (Haw.)Britton & Rose	Su	E	N	MEX-CEAM	TDF
Isolatocereus dumortieri (Scheidw.)Backeb.	Su	T	N	END-MEX	TDF, THF
Mammillaria scrippsiana (Britton & Rose)Orcutt	Su	T	N	END-MEX	THF
Myrtillocactus geometrizans (Mart. ex Pfeiff.) Console	Su	T	N	END-MEX	TDF, THF
Nopalea cochenillifera (L.)Salm-Dyck	Su	T	N	AME	TDF, THF
Opuntia atropes Rose	Su	T	N	END-MEX	THF
Opuntia ficus-indica (L.)Mill.	Su	T	N	MEX-SOAM	THF
Opuntia fuliginosa Griffiths	Su	T	N	END-MEX	THF
Opuntia jaliscana Bravo	Su	T	N	END-MEX	THF
Opuntia joconostle F.A.C. Weber	Su	T	N	END-MEX	THF
Opuntia pubescens H.L.Wendl. ex Pfeiff.	Su	T	N	AME	THF
Opuntia pumila Rose	Su	T	N	END-MEX	THF
Opuntia undulata Griffiths	Su	T	N	END-MEX	TDF, THF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Pachycereus pecten-aboriginum (Engelm. ex S. Watson) Britton & Rose	Su	T	N	END-MEX	TDF, THF
Pereskia aculeata Mill.	S	T	N	MEX-SOAM	THF
Pereskiopsis diguetii (F.A.C. Weber)Britton & Rose	Su	T	N	END-MEX	TDF, THF
Stenocereus queretaroensis (F.A.C. Weber ex Mathes.)Buxb.	Su	T	N	END-MEX	TDF, THF
Campanulaceae					
* *Diastatea micrantha* (Kunth)McVaugh	H	T	N	MEX-SOAM	TDF, THF
* *Diastatea tenera* (A. Gray)McVaugh	H	T	N	MEX-CEAM	TDF, THF
* *Lobelia fenestralis* Cav.	H	T	N	USA-MEX	TDF, POF
Lobelia hartwegii Benth. ex A.DC.	H	T	N	END-MEX	OF, POF, PF, POF
Lobelia jaliscensis McVaugh	H	T	N	END-MEX	OF, POF, PF, POF
* *Lobelia laxiflora* Kunth	H	T	N	AME	OF, POF
Cannabaceae					
* *Celtis ehrenbergiana* (Klotzsch)Liebm.	S	T	N	DIS	THF
Celtis reticulata Torr.	T	T	N	USA-MEX	TDF
Caprifoliaceae					
Valeriana urticifolia Kunth	H	T	N	MEX-SOAM	TDF
Caricaceae					
Jarilla heterophylla (Cerv. ex La Llave)Rusby	V	T	N	END-MEX	TDF
Caryophyllaceae					
* *Drymaria glandulosa* Bartl.	H	T	N	AME	TDF
Drymaria leptophylla (Cham. & Schltdl.)Fenzl ex Rohrb.	H	T	N	USA-MEX	TDF
* *Drymaria villosa* Schltdl. & Cham.	H	T	N	MEX-CEAM	TDF
Cistaceae					
Helianthemum sp.	Sf	T	N	USA-MEX	OF
Cleomaceae					
Cleomella jaliscensis E. Villegas & R. Delgad.	S	T	N	END-WEST	TDF, THF
Clethraceae					
Clethra hartwegii Britton	T	T	N	END-MEX	OF, POF, PF, POF
Convolvulaceae					
* *Convolvulus arvensis* L.	V	T	I (Eu)	COS	TDF, THF
* *Cuscuta corymbosa* Ruiz & Pav.	H	Pa	N	AME	TDF, THF
* *Cuscuta umbellata* Kunth	H	Pa	N	AME	TDF, THF
Evolvulus alsinoides (L.)L.	H	T	N	PAN	POF
Ipomoea bracteata Cav.	V	T	N	END-MEX	TDF
Ipomoea capillacea (Kunth)G. Don	H	T	N	AME	TDF, THF
Ipomoea coccinea L.	V	T	N	NOA	TDF
* *Ipomoea intrapilosa* Rose	T	T	N	END-MEX	TDF
* *Ipomoea mairetii* Choisy	V	T	N	MEX-CEAM	TDF
* *Ipomoea murucoides* Roem. & Schult.	T	T	N	MEX-CEAM	TDF
* *Ipomoea neei* (Spreng.)O'Donell	L	T	N	MEX-CEAM	TDF
* *Ipomoea nil* (L.) Roth	V	T	N	PAN	TDF
Ipomoea parasitica (Kunth)G. Don	V	T	N	NEO	TDF
Ipomoea pauciflora M. Martens & Galeotti subsp. *pauciflora*	T	T	N	END-MEX	TDF
* *Ipomoea purpurea* (L.)Roth	V	T	N	COS	TDF, THF
* *Merremia quinquefolia* (L.)Hallier f.	V	T	N	AME	TDF, THF
* *Quamoclit coccinea* var. *coccinea*	V	T	N	USA-MEX	TDF
* *Turbina corymbosa* (L.) Raf.	V	T	N	AME	TDF, THF
Crassulaceae					
Echeveria waltheri Moran & J.Meyrán	Su	T	N	END-MEX	TDF
Sedum ebracteatum Moc. & Sessé ex DC.	H	T	N	END-MEX	TDF, POF
Sedum greggii Hemsl.	H	T	N	END-MEX	OF, POF, PF, POF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Sedum jaliscanum S. Watson	H	T	N	END-MEX	TDF, POF
Cucurbitaceae					
* *Apodanthera undulata* A. Gray	V	T	N	USA-MEX	TDF, THF
* *Sechiopsis triquetra* (Moc. & Sessé ex Ser.) Naudin	V	T	N	END-MEX	TDF, THF
* *Sicyos microphyllus* Kunth	H	T	N	END-MEX	TDF, THF
Ericaceae					
Arbutus tessellata P.D. Sørensen	T	T	N	END-MEX	OF, POF, PF, POF
Arbutus xalapensis Kunth	T	T	N	USA-CEAM	OF, POF, PF, POF
Arctostaphylos pungens Kunth	S	T	N	USA-MEX	OF, POF, PF, POF
Comarostaphylis discolor (Hook.)Diggs	S	T	N	END-MEX	OF, POF, PF, POF
Vaccinium stenophyllum Steud.	S	T	N	END-MEX	OF, POF, PF, POF
Euphorbiaceae					
* *Acalypha alopecuroidea* Jacq.	H	T	N	AME	TDF, THF
Acalypha mollis Kunth	S	T	N	MEX-CEAM	TDF, THF
Acalypha ocymoides Kunth	H	T	N	END-MEX	TDF, THF, POF
Acalypha setosa A. Rich.	H	T	N	MEX-SOAM	TDF, THF
Cnidoscolus spinosus Lundell	T	T	N	END-MEX	TDF
Croton adspersus Benth.	S	T	N	MEX-CEAM	TDF
* *Croton ciliatoglandulifer* Ortega	S	T	N	USA-CEAM	TDF
Croton flavescens Greenm.	S	T	N	END-MEX	TDF
* *Euphorbia anychioides* Boiss.	H	T	N	MEX-CEAM	TDF
Euphorbia ariensis Kunth	H	T	N	MEX-CEAM	TDF
Euphorbia colletioides Benth.	S	T	N	MEX-CEAM	TDF
Euphorbia cotinifolia L.	S	T	N	NEO	TDF
* *Euphorbia cyathophora* Murray	H	T	N	USA-CEAM	TDF, THF, POF
Euphorbia cymosa Poir.	Sf	T	N	MEX-CEAM	TDF
* *Euphorbia densiflora* (Klotzsch)Klotzsch	H	T	N	MEX-CEAM	TDF
* *Euphorbia dentata* Michx.	H	T	N	COS	TDF
* *Euphorbia graminea* Jacq.	H	T	N	NEO	TDF
* *Euphorbia heterophylla* L.	H	T	N	COS	TDF, THF, POF
* *Euphorbia hirta* L.	H	T	N	NEO	TDF
Euphorbia lineata S.Watson	H	T	N	END-MEX	TDF
* *Euphorbia nutans* Lag.	S	T	N	AME	TDF
* *Euphorbia serpens* Kunth	H	T	N	AME	TDF, THF
Manihot chlorosticta Standl. & Goldman	S	T	N	END-MEX	TDF, THF
Tragia nepetifolia Cav.	H	T	N	AME	TDF
* *Ricinus communis* L.	S	T	I (Af)	PAN	SV
Fabaceae					
* *Acacia cochliacantha* Humb. & Bonpl. ex Willd.	S	T	N	END-MEX	THF
* *Acacia farnesiana* (L.)Willd.	S	T	N	AME	TDF, THF
Acacia macilenta Rose	S	T	N	END-MEX	THF
* *Acacia pennatula* (Schltdl. & Cham.)Benth.	S	T	N	AME	THF
Acaciella angustissima (Mill.) Britton & Rose	S	T	N	AME	TDF
* *Astragalus guatemalensis* Hemsl.	H	T	N	MEX-CEAM	TDF
Astragalus scutaneus Barneby	H	T	N	END-WEST	TDF
Caesalpinia pulcherrima (L.) Sw.	T	T	N	AME	TDF
Calliandra houstoniana var. *anomala* (Kunth) Barneby	S	T	N	MEX-CEAM	OF, POF, PF, POF
Cologania broussonetii (Balb.) DC.	V	T	N	NEO	OF, POF, PF, POF
Coursetia caribaea (Jacq.)Lavin	S	T	N	NEO	OF, POF, PF, POF
Coursetia glandulosa A. Gray	S	T	N	USA-MEX	TDF
* *Crotalaria mollicula* Kunth	Sf	T	N	MEX-CEAM	TDF
* *Crotalaria rotundifolia* J.F.Gmel.	H	T	N	USA-CEAM	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
* *Dalea foliolosa* (Aiton) Barneby	H	T	N	MEX-CEAM	TDF, OF
Dalea obovatifolia Ortega	H	T	N	END-MEX	TDF
Desmodium affine Schltdl.	H	T	N	MEX-SOAM	TDF
Desmodium cinereum (Kunth) DC.	S	T	N	MEX-CEAM	TDF
Desmodium neomexicanum A. Gray	H	T	N	AME	TDF
Desmodium orbiculare Schltdl.	S	T	N	END-MEX	TDF
* *Desmodium procumbens* var. *transversum* (Robinson & Greenm.)B.G. Schub.	H	T	N	MEX-CEAM	TDF
Enterolobium cyclocarpum (Jacq.)Griseb.	T	T	N	NEO	TDF
Eriosema diffusum (Kunth)G. Don	S	T	N	MEX-CEAM	TDF
* *Eriosema pulchellum* (Kunth)G. Don	Sf	T	N	MEX-CEAM	TDF
Erythrina breviflora DC.	S	T	N	END-MEX	TDF
Eysenhardtia polystachya (Ortega)Sarg.	T	T	N	END-MEX	OF
* *Indigofera suffruticosa* Mill.	S	T	N	NEO	TDF
Lotus sp.	Sf	T	N	MEX-CEAM	POF
Lupinus exaltatus Zucc.	H	T	N	END-MEX	OF, POF, PF, POF
Lysiloma acapulcense (Kunth)Benth.	T	T	N	MEX-CEAM	TDF
Lysiloma divaricatum (Jacq.)J.F. Macbr.	T	T	N	END-MEX	TDF
* *Macroptilium atropurpureum* (DC.)Urb.	V	T	N	NEO	TDF, THF, POF
Macroptilium gibbosifolium (Ortega)A. Delgado	V	T	N	USA-CEAM	TDF, THF, POF
* *Marina neglecta* (Robinson)Barneby	H	T	N	END-MEX	TDF
* *Melilotus indicus* (L.) All.	H	T	I (Eu)	COS	TDF
Mimosa minutifolia B.L. Rob. & Greenm.	S	T	N	END-WEST	TDF
Nissolia microptera Poir.	V	T	N	END-MEX	TDF
* *Parkinsonia aculeata* L.	T	T	N	NEO	TDF
* *Phaseolus coccineus* L.	V	T	N	MEX-CEAM	TDF
Phaseolus jaliscanus Piper	V	T	N	END-WEST	TDF, THF, POF
* *Pithecellobium dulce* (Roxb.)Benth.	T	T	N	USA-CEAM	THF
* *Prosopis laevigata* (Willd.)M.C.Johnst.	T	T	N	USA-MEX	THF, TDF, HV
Senna atomaria (L.) H.S. Irwin & Barneby	S	T	N	NEO	TDF
* *Senna hirsuta* var. *hirta* H.S. Irwin & Barneby	S	T	N	NEO	TDF
* *Trifolium amabile* Kunth	H	T	N	USA-CEAM	TDF
* *Vigna luteola* (Jacq.)Benth.	V	T	N	PAN	TDF
* *Zornia reticulata* Sm.	H	T	N	MEX-CEAM	OF, POF, PF, POF
Fagaceae					
Quercus candicans Née	T	T	N	MEX-CEAM	OF, POF, PF, POF
Quercus castanea Née	T	T	N	END-MEX	OF, POF, PF, POF
Quercus crassipes Bonpl.	T	T	N	END-MEX	OF, POF, PF, POF
Quercus deserticola Trel.	T	T	N	END-MEX	POF
Quercus gentryi C.H. Mull.	T	T	N	END-MEX	OF, POF, PF, POF
Quercus laeta Liebm.	T	T	N	END-MEX	POF, TDF
Quercus magnoliifolia Née	T	T	N	MEX-CEAM	OF, POF, PF, POF
Quercus obtusata Bonpl.	T	T	N	END-MEX	POF, BE
Quercus resinosa Liebm.	T	T	N	END-MEX	OF, POF, PF, POF
Quercus salicifolia Née	T	T	N	MEX-CEAM	POF, TDF
Quercus subspathulata Trel.	T	T	N	END-MEX	OF, TDF
Fouquieriaceae					
Fouquieria formosa Kunth	S	T	N	USA-MEX	TDF
Gentianaceae					
Centaurium calycosum (Buckley)Fernald	H	T	N	USA-MEX	TDF, THF
Eustoma exaltatum (L.)Salisb. ex G. Don	H	T	N	AME	AV

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Lamiaceae					
Condea albida (Kunth)Harley & J.F.B. Pastore	S	T	N	MEX-CEAM	TDF
Cunila polyantha Benth.	H	T	N	MEX-CEAM	TDF
Hyptis albida Kunth	S	T	N	AME	PF, POF
* *Leonotis nepetifolia* (L.)R.Br.	H	T	N	AME	TDF, OF
* *Lepechinia caulescens* (Ortega)Epling	H	T	N	MEX-CEAM	TDF
* *Prunella vulgaris* L.	H	T	N	COS	TDF
* *Salvia coccinea* Buc'hoz ex Etl.	H	T	N	AME	OF, POF, PF, POF
Salvia iodantha Fernald	S	T	N	END-MEX	POF, BE
* *Salvia lavanduloides* Kunth	H	T	N	MEX-CEAM	OF, POF
* *Salvia misella* Kunth	H	T	N	AME	THF
Salvia mocinoi Benth.	Sf	T	N	MEX-CEAM	POF
Salvia nepetoides Kunth	H	T	N	END-MEX	POF
Salvia mexicana L.	H	T	N	END-MEX	OF, POF, PF, POF
Salvia reptans Jacq.	H	T	N	USA-MEX-CEAM	POF
Salvia setulosa Fernald	H	T	N	END-MEX	OF
* *Stachys coccinea* Ortega	H	T	N	AME	OF, POF, PF, POF
Stachys germanica var. *polystachya* (Ten.) Nyman	H	T	N	NOA	OF, POF, PF, POF
Vitex mollis Kunth	T	T	N	END-MEX	TDF
Lentibulariaceae					
Pinguicula oblongiloba A.DC.	H	T	N	END-MEX	OF, POF, PF, POF
Pinguicula parvifolia B.L. Rob.	H	T	N	END-MEX	OF
Linderniaceae					
Lindernia anagallidea (Michx.)Pennell	H	T	N	USA-CEAM	AV
Loasaceae					
Gronovia scandens L.	H	T	N	AME	TDF
Loranthaceae					
Cladocolea grahamii (Benth.)Tiegh.	S	Pa	N	END-MEX	OF
Cladocolea microphylla (Kunth)Kuijt	S	Pa	N	END-MEX	OF, POF, PF, POF
Notanthera palmeri (S. Wats.)Engl.	S	Pa	N	END-MEX	OF, PF
* *Psittacanthus calyculatus* (DC.) G. Don.	S	Pa	N	MEX-SOAM	OF, POF, PF, POF
Lythraceae					
* *Cuphea aequipetala* Cav.	H	T	N	MEX-CEAM	TDF, OF
Cuphea hookeriana Walp.	H	T	N	MEX-CEAM	TDF, OF
Cuphea humifusa S.A. Graham	H	T	N	END-MEX	TDF
Cuphea jorullensis (Kunth) Link	H	T	N	END-MEX	TDF
Cuphea llavea Lex.	H	T	N	END-MEX	POF, PF
Heimia salicifolia Link	S	T	N	NOA	TDF
Malpighiaceae					
Galphimia glauca Cav.	S	T	N	MEX-CEAM	TDF
* *Gaudichaudia albida* Schltdl. & Cham.	L	T	N	MEX-SOAM	TDF
Gaudichaudia congestiflora A. Juss.	L	T	N	END-MEX	TDF
* *Malpighia mexicana* A. Juss.	S	T	N	END-MEX	TDF
Malvaceae					
Abutilon abutiloides (Jacq.)Garcke ex Hochr.	H	T	N	USA-MEX	TDF
Abutilon reventum S. Watson	Sf	T	N	END-MEX	TDF
Abutilon simulans Rose	H	T	N	END-MEX	TDF
* *Anoda acerifolia* Cav.	H	T	N	AME	TDF
* *Anoda cristata* (L.) Schltdl.	H	T	N	AME	TDF
Ceiba aesculifolia (Kunth) Britten & Baker f.	T	T	N	MEX-CEAM	TDF
Guazuma ulmifolia Lam.	S	T	N	MEX-CEAM	TDF
* *Herissantia crispa* (L.) Brizicky	H	T	N	NEO	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Malvastrum bicuspidatum (S. Watson)Rose	Sf	T	N	END-MEX	TDF
* *Malvastrum coromandelianum* (L.)Garcke	Sf	T	N	COS	TDF
* *Malvaviscus arboreus* Cav.	T	T	N	MEX-CEAM	TDF, PF, POF
Pseudabutilon orientale (Standl. & Steyerm.) Fryxell	Sf	T	N	END-MEX	TDF
* *Sida abutifolia* Mill.	H	T	N	AME	THF
Sida barclayi Baker f.	H	T	N	MEX-CEAM	TDF
* *Sida glabra* Mill.	H	T	N	PAN	TDF
* *Sida rhombifolia* L.	S	T	N	PAN	TDF
* *Sphaeralcea angustifolia* (Cav.) G. Don	H	T	N	NEO	TDF
Triumfetta gonophora W.W. Thomas & McVaugh	S	T	N	END-WEST	TDF
Triumfetta semitriloba Jacq.	S	T	N	NEO	TDF, POF
* *Waltheria indica* L.	Sf	T	N	PAN	TDF, THF
Martyniaceae					
* *Martynia annua* L.	H	T	N	MEX-CEAM	TDF, THF
* *Proboscidea louisianica* (Mill.)Thell.	H	T	N	USA-MEX	PF, TDF
Melastomataceae					
Clidemia matudae L.O.Williams	S	T	N	MEX-CEAM	OF, POF, PF, POF
Menispermaceae					
Cocculus diversifolius DC.	V	T	N	USA-MEX	TDF
Moraceae					
Ficus cotinifolia subsp. *cotinifolia* Kunth in H.B.K.	T	T	N	MEX-CEAM	TDF
Ficus cotinifolia subsp. *myxaefolia* Kunth & Bouché)Carvajal	T	T	N	END-MEX	TDF
Ficus crocata (Miq.) Miq.	T	T	N	NEO	TDF
Ficus goldmanii subsp. *horaliae* Carvajal	T	T	N	MEX-CEAM	TDF
Ficus insipida subsp. *radulina* (S. Watson) Carvajal	T	T	N	END-MEX	TDF
Ficus insipida Willd. subsp. *insipida*	T	T	N	NEO	TDF
Ficus pertusa L.f.	T	T	N	NEO	TDF
Ficus petiolaris Kunth	T	T	N	END-MEX	TDF
Nyctaginaceae					
* *Allionia incarnata* L.	H	T	N	AME	TDF
* *Commicarpus scandens* (L.) Standl.	Sf	T	N	AME	TDF
* *Mirabilis jalapa* L.	H	T	N	AME	TDF
Mirabilis viscosa Cav.	H	T	N	AME	TDF
Pisoniella arborescens (Lag. & Rodr.)Standl.	S	T	N	AME	TDF
* *Salpianthus purpurascens* (Cav. ex Lag.)Hook. & Arn.	H	T	N	MEX-SOAM	THF
Oleaceae					
Fraxinus uhdei (Wenz.)Lingelsh.	T	T	N	MEX-CEAM	TDF, THF, POF
Onagraceae					
* *Lopezia miniata* Lag. ex DC.	H	T	N	MEX-CEAM	TDF
* *Ludwigia peploides* (Kunth)P.H.Raven	H	A	N	AME	TDF
Opiliaceae					
Agonandra racemosa (DC.)Standl.	S	T	N	END-MEX	TDF
Orobanchaceae					
Castilleja mcvaughii N.H. Holmgren	S	T	N	END-WEST	OF, POF, PF, POF
* *Castilleja tenuifolia* M. Martens & Galeotti	H	T	N	END-MEX	TDF, POF
Lamourouxia multifida Kunth	H	T	N	MEX-CEAM	TDF
Pedicularis tripinnata M. Martens & Galeotti	H	T	N	END-MEX	TDF
Oxalidaceae					
* *Oxalis latifolia* Kunth	H	T	N	AME	PF, POF
Papaveraceae					
* *Argemone ochroleuca* Sweet	H	T	N	END-MEX	TDF, THF
* *Bocconia frutescens* L.	T	T	N	MEX-CEAM	TDF, THF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Passifloraceae					
Passiflora exsudans Zucc.	V	T	N	END-MEX	TDF
* *Passiflora foetida* L.	V	T	N	USA-CEAM	TDF
Phrymaceae					
Leucocarpus perfoliatus (Kunth)Benth.	S	T	N	AME	TDF
Phytolaccaceae					
Ledenbergia macrantha Standl.	T	T	N	MEX-CEAM	TDF
* *Phytolacca icosandra* L.	H	T	N	PAN	TDF, THF
* *Rivinia humilis* L.	H	T	N	AME	TDF, THF
Plantaginaceae					
* *Bacopa monnieri* (L.) Wettst.	H	A	N	COS	AV
* *Mecardonia procumbens* (Mill.) Small	H	T	N	AME	THF, AV, HV
* *Plantago major* L.	H	T	I (Ea)	COS	AV
Russelia ternifolia Kunth	S	T	N	END-MEX	TDF, OF
Schistophragma pusillum Benth.	H	T	N	MEX-CEAM	TDF, OF
Plumbaginaceae					
Plumbago pulchella Boiss.	Sf	T	N	END-MEX	TDF, OF
Plumbago zeylanica L.	Sf	T	N	DIS	TDF, OF
Polemoniaceae					
* *Loeselia mexicana* (Lam.)Brand	Sf	T	N	USA-MEX	OF
Polygalaceae					
Monnina xalapensis Kunth	H	T	N	MEX-CEAM	OF, POF
Polygala albowiana Chodat	H	T	N	END-MEX	TDF, OF
Polygonaceae					
* *Polygonum lapathifolium* L.	H	A	I (Ea)	NEO	AV
Portulacaceae					
* *Portulaca oleracea* L.	H	T	I (Eu)	COS	TDF
Primulaceae					
* *Anagallis arvensis* L.	H	T	I (Ea)	COS	TDF
Parathesis villosa Lundell	S	T	N	END-MEX	TDF
Ranunculaceae					
* *Clematis dioica* L.	V	T	N	MEX-CEAM	TDF, THF
Thalictrum peltatum DC.	H	T	N	END-MEX	OF, POF, PF, POF
Resedaceae					
Oligomeris linifolia (Vahl ex Hornem.)J.F. Macbr.	H	T	N	USA-MEX	HV
Rhamnaceae					
Colubrina triflora Brongn. ex Sweet	S	T	N	MEX-CEAM	TDF
Karwinskia humboldtiana (Schult.) Zucc.	S	T	N	USA-MEX	TDF
Karwinskia latifolia Standl.	S	T	N	END-MEX	TDF
Rosaceae					
Crataegus mexicana Moci.& Sessé ex DC.	T	T	N	MEX-CEAM	THF
Lachemilla aphanoides (Mutis ex L. f.) Rothm.	H	T	N	MEX-SOAM	TDF
Lachemilla sibbaldiifolia (Kunth) Rydb.	H	T	N	MEX-CEAM	TDF
Prunus serotina subsp. *capuli* (Cav. ex Spreng.) McVaugh	T	T	N	MEX-CEAM	TDF
Rubus adenotrichos Schltdl.	V	T	N	NEO	PF
Rubiaceae					
* *Bouvardia ternifolia* (Cav.)Schltdl.	Sf	T	N	USA-MEX	OF, POF
* *Chiococca alba* (L.) Hitchc.	S	T	N	NEO	TDF
* *Crusea diversifolia* (Kunth)W.R. Anderson	H	T	N	AME	TDF, OF
* *Crusea longiflora* (Willd. ex Roem. & Schult.) W.R. Anderson	H	T	N	MEX-SOAM	TDF, OF
Galium mexicanum Kunth	V	T	N	USA-CEAM	PF, POF
Randia capitata DC.	T	T	N	END-MEX	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Rutaceae					
* *Ptelea trifoliata* L.	T	T	N	NOA	TDF
Salicaceae					
Salix bonplandiana Kunth	T	A	N	AME	AV
Salix humboldtiana Willd.	T	A	N	AME	AV
Xylosma flexuosum (Kunth)Hemsl.	T	T	N	NOA	TDF
Santalaceae					
Phoradendron brachystachyum (DC.)Oliv.	S	Pa	N	END-MEX	OF, POF, PF, POF
Phoradendron falcatum Eichler	S	Pa	N	MEX-CEAM	PF
Phoradendron reichenbachianum (Seem.)Oliv.	S	Pa	N	MEX-CEAM	TDF, THF, POF
Sapindaceae					
* *Cardiospermum halicacabum* L.	V	T	N	PAN	TDF
* *Dodonaea viscosa* (L.) Jacq.	S	T	N	PAN	TDF, POF
* *Sapindus saponaria* L.	T	T	N	AME	TDF
Serjania sp.	V	T	N	NEO	TDF
Scrophulariaceae					
Buddleia parviflora Kunth	S	T	N	USA-MEX	OF, POF
Buddleia sessiliflora Kunth	S	T	N	USA-MEX	TDF, THF
* *Capraria biflora* L.	Sf	T	N	AME	TDF, THF
Solanaceae					
Calibrachoa parviflora (Juss.)D'Arcy	Sf	T	N	DIS	TDF
Cestrum aurantiacum Lindl.	Sf	T	N	MEX-CEAM	TDF
Cestrum nitidum M. Martens & Galeotti	S	T	N	END-MEX	TDF
Cestrum thyrsoideum Kunth	S	T	N	END-MEX	OF, TDF
Cestrum tomentosum L.f.	S	T	N	MEX-CEAM	POF
* *Datura inoxia* Mill	H	T	N	AME	TDF
* *Datura stramonium* L.	H	T	N	AME	THF
* *Jaltomata procumbens* (Cav.)J.L.Gentry	H	T	N	MEX-CEAM	PF
* *Lycianthes moziniana* (Dunal)Bitter	H	T	N	END-MEX	TDF
Lycium carolinianum Walter	S	T	N	NOA	TDF
* *Nicandra physalodes* (L.)Gaertn.	H	T	N	COS	TDF
* *Nicotiana glauca* Graham	S	T	I (Sa)	COS	THF
* *Nicotiana plumbaginifolia* Viv.	H	T	N	AME	THF
Physalis lignescens Waterf.	H	T	N	END-MEX	TDF
* *Physalis nicandroides* Schltdl.	H	T	N	MEX-CEAM	TDF
* *Physalis philadelphica* Lam.	H	T	N	AME	TDF
Physalis waterfallii O. Vargas, M. Martínez & Dávila	H	T	N	END-MEX	TDF
Solanum adscendens Sendtn.	H	T	N	DIS	THF
* *Solanum americanum* Mill.	Sf	T	N	COS	THF,OF
Solanum aphyodendron S. Knapp	S	T	N	AME	TDF, POF
Solanum brevipedicellatum K.E. Roe	S	T	N	MEX-CEAM	TDF
* *Solanum cardiophyllum* Lindl.	H	T	N	USA-CEAM	THF
* *Solanum elaeagnifolium* Cav.	Sf	T	N	AME	PF, POF
Solanum erianthum D. Don	S	T	N	MEX-SOAM	TDF
Solanum ferrugineum Jacq.	S	T	N	MEX-CEAM	TDF, POF
* *Solanum fructo-tecto* Cav.	Sf	T	N	END-MEX	TDF
Solanum guerreroense Correll	H	T	N	END-MEX	TDF
Solanum hougasii Correll	H	T	N	END-MEX	TDF
Solanum lanceolatum Cav.	S	T	N	MEX-CEAM	TDF, POF
Solanum nigricans M. Martens & Galeotti	S	T	N	MEX-CEAM	TDF
* *Solanum pseudocapsicum* L.	Sf	T	I (Eu)	PAN	TDF, POF
* *Solanum rostratum* Dunal	Sf	T	N	AME	TDF, POF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
* *Solanum rudepannum* Dunal	S	T	N	AME	TDF
Solanum seaforthianum Andrews	V	T	N	COS	TDF
Solanum sisymbriifolium Lam.	Sf	T	N	AME	TDF
* *Solanum tridynamum* Dunal	Sf	T	N	END-MEX	TDF
Solanum trifidum Correll	H	T	N	END-MEX	TDF, POF
* *Solanum umbellatum* Mill.	Sf	T	N	AME	TDF, POF
Talinaceae					
Talinum paniculatum (Jacq.)Gaertn.	H	T	N	NEO	TDF
Verbenaceae					
* *Bouchea prismatica* (L.)Kuntze	H	T	N	AME	TDF
* *Lantana camara* L.	S	T	N	AME	TDF
Lantana hirta Graham	S	T	N	AME	TDF, POF
Lantana involucrata L.	S	T	N	AME	TDF
Lippia umbellata Cav.	T	T	N	MEX-CEAM	AV
* *Phyla nodiflora* (L.)Greene	H	A	N	PAN	AV
Priva aspera Kunth	Sf	T	N	MEX-CEAM	TDF, POF
* *Verbena bipinnatifida* Nutt.	H	T	N	NOA	PF, OF, POF
Violaceae					
* *Hybanthus verbenaceus* (Kunth)Loes.	H	T	N	MEX-CEAM	OF, POF, PF, POF
Viola grahamii Benth.	H	T	N	MEX-CEAM	OF, POF, PF, POF
Vitaceae					
* *Cissus verticillata* (L.)Nicolson & C.E. Jarvis	V	T	N	NEO	THF
Vitis berlandieri Planch.	L	T	N	USA-MEX	TDF, OF
Zygophyllaceae					
* *Tribulus cistoides* L.	H	T	N	PAN	TDF
Monocotiledódeas					
Alismataceae					
Sagittaria macrophylla Zucc.	H	A	N	END-MEX	AV
Amaryllidaceae					
Zephyranthes fosteri	H	T	N	END-MEX	AV
Araceae					
* *Lemna gibba* L.	H	A	N	COS	AV
* *Xanthosoma robustum* Schott	H	A	N	MEX-CEAM	AV
Zantedeschia aethiopica (L.)Spreng.	H	T	I (Sf)	PAN	AV
Asparagaceae					
Agave angustifolia Haw.	Ro	T	N	MEX-CEAM	TDF, THF, POF
Agave inaequidens K.Koch	Ro	T	N	END-MEX	TDF, THF, POF
Agave schidigera Lem.	Ro	T	N	END-MEX	TDF, OF
Bessera elegans Schult.f.	H	T	N	END-MEX	OF, PF, POF
Echeandia durangensis (Greenm.) Cruden	H	T	N	END-MEX	TDF, THF, POF
Echeandia occidentalis Cruden	H	T	N	END-WEST	TDF, THF, POF
Echeandia parviflora Baker	H	T	N	MEX-CEAM	TDF, THF, POF
Manfreda scabra (Ortega)McVaugh	H	T	N	MEX-CEAM	OF
Milla biflora Cav.	H	T	N	USA-MEX-CEAM	PF, OF
Polianthes geminiflora var. *clivicola* McVaugh	H	T	N	END-MEX	OF
Prochnyanthes mexicana (Zucc.)Rose	H	T	N	END-WEST	OF, POF, PF, POF
Bromeliaceae					
Pitcairnia sp.	Ro	T	N	NEO	POF
Tillandsia makoyana Baker	H	E	N	END-MEX	OF
Tillandsia plumosa Baker	H	E	N	END-MEX	OF
Tillandsia recurvata (L.) L.	H	E	N	AME	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Tillandsia schiedeana Steud.	H	E	N	MEX-SOAM	TDF, OF
Tillandsia usneoides (L.)L.	H	E	N	AME	TDF, OF
Cannaceae					
Canna glauca L.	H	A	N	AME	AV
* *Canna indica* L.	H	A	N	MEX-SOAM	AV
Commelinaceae					
* *Commelina diffusa* Burm. f.	H	T	N	NEO	TDF, THF, POF
* *Commelina pallida* Willd.	H	T	N	END-MEX	TDF, THF, POF
Gibasis triflora (M. Martens & Galeotti) D.R. Hunt	H	T	N	MEX-CEAM	TDF, THF, POF
Tradescantia sp.	H	T	N	AME	OF, TDF
* *Tripogandra purpurascens* (Schauer) Handlos	H	T	N	MEX-SOAM	TDF, THF, POF
Cyperaceae					
Amphiscirpus nevadensis (S. Watson) Oteng-Yeb.	H	T	N	DIS	THF, AV, HV
* *Bulbostylis funckii* (Steud.) C.B. Clarke	H	A	N	AME	TDF, THF, POF
Bulbostylis juncoides (Vahl) Kük. ex Osten	H	A	N	AME	TDF, THF, POF
Cyperus digitatus Roxb.	H	A	N	COS	TDF, THF, POF
* *Cyperus esculentus* L.	H	A	N	AME	AV
* *Cyperus odoratus* L.	H	T	N	COS	TDF, THF, AV
* *Cyperus rotundus* L.	H	T	I (Ea)	NEO	TDF, THF, AV
Eleocharis macrostachya Britton	H	T	N	AME	AV
* *Rhynchospora colorata* (L.)H. Pfeiff.	H	A	N	AME	TDF, THF, POF
* *Schoenoplectus americanus* (Pers.)Volkart	H	A	N	AME	AV
Schoenoplectus pungens (Vahl)Palla	H	A	N	COS	AV
Iridaceae					
* *Sisyrinchium cernuum* (E.P. Bicknell)Kearney	H	T	N	USA-MEX	TDF, THF, POF
Tigridia suarezii Aarón Rodr. & Ortiz-Cat.	H	T	N	END-MEX	POF
Liliaceae					
Calochortus barbatus (Kunt) Painter	H	T	N	END-MEX	TDF, THF, POF
Calochortus purpureus (Kunth) Baker	H	T	N	END-MEX	TDF, THF, POF
Marantaceae					
* *Maranta arundinacea* L.	H	T	N	NEO	TDF, THF, AV
* *Thalia geniculata* L.	H	T	N	AME	TDF, THF, AV
Orchidaceae					
Epidendrum propinquum A.Rich. & Galeotti	H	T	N	MEX-CEAM	OF
Govenia sp.	H	T	N	NEO	OF
Laelia autumnalis (Lex.) Lindl.	H	T	N	END-MEX	OF
Laelia speciosa (Kunth) Schltr.	H	T	N	END-MEX	OF
Malaxis carnosa (Kunth) C. Schweinf.	H	T	N	MEX-CEAM	OF, POF, PF, POF
Oncidium brachyandrum Lindl.	H	T	N	END-MEX	TDF, OF, PF, POF, POF
Triceratostris rhombilabiada subsp. *tamayoi* (Szlach.) Szlach. & R. González	H	T	N	END-MEX	TDF, OF, PF, POF, POF
Poaceae					
* *Aegopogon cenchroides* Humb. & Bonpl. ex Willd.	H	T	N	AME	OF, POF, PF, POF
* *Aristida adscensionis* L.	H	T	N	AME	THF, OF, PF, POF, POF
* *Aristida divaricata* Humb. & Bonpl. ex Willd.	H	T	N	AME	TDF, POF
Aristida jorullensis Kunth	H	T	N	AME	POF
* *Aristida ternipes* Cav.	H	T	N	DIS	TDF
* *Arundo donax* L.	C	A	I (As)	COS	TDF, OF, AV
Bothriochloa barbinodis (Lag.)Herter	H	T	N	AME	POF, POF
Bothriochloa hirtifolia (J. Presl)Henrard	H	T	N	MEX-CEAM	TDF, OF
Bothriochloa laguroides (DC.)Herter	H	T	N	AME	TDF, OF
* *Bouteloua aristidoides* (Kunth)Griseb.	H	T	N	DIS	TDF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Bouteloua curtipendula var. *caespitosa* Gould & Kapadia	H	T	N	AME	TDF, THF
Bouteloua diversispicula Columbus	H	T	N	MEX-CEAM	HV, TDF
Bouteloua elata Reeder & C. Reeder	H	T	N	END-MEX	TDF, THF
* *Bouteloua repens* (Kunth) Scribn. & Merr.	H	T	N	AME	TDF, THF
Bouteloua williamsii Swallen	H	T	N	MEX-CEAM	OF, POF
Brachypodium mexicanum (Roem. & Schult.)Link var. *mexicanum*	H	T	N	AME	PF, POF
Bromus catharticus Vahl	H	T	N	AME	POF
* *Cenchrus brownii* Roem. & Schult.	H	T	N	AME	OF
* *Cenchrus ciliaris* L.	H	T	N	AME	TDF, THF, HV
* *Cenchrus echinatus* L.	H	T	N	AME	TDF, THF, POF
* *Cenchrus longispinus* (Hack.)Fernald	H	T	N	DIS	TDF, THF, POF
Cenchrus setaceus (Forssk.)Morrone	H	T	I (Af)	COS	OF, POF
* *Chaetium bromoides* (J. Presl)Benth. ex Hemsl.	H	T	N	MEX-CEAM	POF, THF,OF
* *Chloris gayana* Kunth	H	T	I (Af)	NEO	TDF, THF, POF
Chloris pycnothrix Trin.	H	T	N	AME	TDF, OF
* *Chloris submutica* Kunth	H	T	N	AME	POF, TDF
* *Chloris virgata* Sw.	H	T	N	AME	TDF, THF, POF
* *Cynodon dactylon* (L.) Pers.	H	T	I (Af)	COS	TDF, THF
* *Cynodon plectostachyus* (K. Schum.) Pilg.	H	T	I (Af)	COS	TDF, THF
* *Dactyloctenium aegyptium* (L.)Willd.	H	T	I (Eu)	PAN	THF, POF
* *Digitaria bicornis* (Lam.)Roem. & Schult.	H	T	I (As)	COS	TDF, THF, POF
* *Digitaria ciliaris* (Retz.)Koeler	H	T	N	AME	TDF, THF, POF
* *Digitaria filiformis* (L.)Koeler	H	T	N	AME	TDF, POF, OF
* *Digitaria sanguinalis* (L.)Scop.	H	T	I (Eu)	COS	TDF, OF
* *Digitaria ternata* (A. Rich.) Stapf	H	T	I (Af)	COS	TDF, HV
* *Distichlis spicata* (L.)Greene	H	T	N	NOA	HV
* *Echinochloa crus-galli* (L.)P. Beauv.	H	T	I (Eu)	DIS	AV, POF, OF
* *Echinochloa crus-pavonis* (Kunth)Schult.	H	T	N	AME	AV, OF
* *Eleusine indica* (L.)Gaertn.	H	T	I (In)	PAN	TDF, THF, POF
* *Eragrostis cilianensis* (All.)Janch.	H	T	I (Eu)	COS	TDF, POF
* *Eragrostis ciliaris* (L.)R. Br.	H	T	N	AME	TDF, POF
* *Eragrostis intermedia* Hitchc.	H	T	N	AME	TDF, POF
* *Eragrostis pectinacea* (Michx.)Nees	H	T	N	AME	TDF, THF, POF
* *Eriochloa acuminata* (J. Presl)Kunth	H	T	N	NOA	TDF, THF, POF
Eriochloa nelsonii Scribn. & J.G. Sm.	H	T	N	MEX-CEAM	TDF, OF
Festuca breviglumis Swallen	H	T	N	MEX-CEAM	PF, POF
* *Festuca lugens* (E. Fourn.)Hitchc. ex Hern.-Xol.	H	T	N	END-MEX	POF, PF, POF
Heteropogon contortus (L.)P. Beauv. ex Roem. & Schult.	H	T	N	COS	TDF, POF, HV
* *Hilaria cenchroides* Kunth	H	T	N	NOA	TDF, THF, POF
* *Hilaria ciliata* (Scribn.)Nash	H	T	N	END-MEX	TDF
* *Hordeum vulgare* L.	H	T	N	COS	PF, POF
* *Hyparrhenia rufa* (Nees)Stapf	H	T	I (Af)	COS	TDF, OF, THF
* *Ixophorus unisetus* (J. Presl) Schltdl.	H	T	N	END-MEX	TDF, THF
Jouvea pilosa (J. Presl) Scribn.	H	T	N	MEX-CEAM	THF, AV, HV
Lasiacis nigra Davidse	H	T	N	AME	TDF, THF, POF
Leptochloa fusca subsp. *uninervia* (J. Presl) P.M. Peterson & N. Snow	H	T	N	AME	TDF, HV
* *Melinis repens* (Willd.)Zizka	H	T	I (Af)	NEO	TDF, OF, POF, THF
Muhlenbergia cenchroides (Humb. & Bonpl. ex Willd.) P.M. Peterson	H	T	N	AME	OF, POF, PF, POF
Muhlenbergia ciliata (Kunth)Trin.	H	T	N	AME	OF, POF, PF, POF

Appendix 1. Continuation.

Species	Biological Form	Hábitat	Introduced/ Native	Distribution	Vegetation Type
Muhlenbergia diversiglumis Trin.	H	T	N	AME	OF, POF
* *Muhlenbergia implicata* (Kunth) Trin.	H	T	N	AME	POF, THF
* *Muhlenbergia macroura* (Humb. Bonpl. & Kunth) Hitchc.	H	T	N	NOA	OF, POF, PF, POF
Muhlenbergia rigida (Kunth) Kunth	H	T	N	AME	POF, OF, PF
Muhlenbergia robusta (E. Fourn.)Hitchc.	H	T	N	MEX-CEAM	OF, POF, PF
* *Muhlenbergia tenuifolia* (Kunth) Kunth	H	T	N	AME	OF, POF, PF, POF
* *Nassella mucronata* (Kunth)R.W. Pohl	H	T	N	AME	OF, POF
* *Oplismenus burmannii* (Retz.)P. Beauv.	H	T	N	COS	TDF, POF, OF
* *Oplismenus compositus* (L.)P. Beauv.	H	T	N	COS	TDF, OF, THF
Otatea acuminata (Munro)C.E.Calderón ex Soderstr.	C	T	N	MEX-CEAM	TDF
Panicum ghiesbreghtii E. Fourn.	H	T	N	AME	TDF, THF, OF
* *Panicum hirticaule* J. Presl	H	T	N	AME	TDF, OF
* *Panicum maximum* Jacq.	H	T	I (Af)	NEO	TDF, THF
Paspalum conspersum Schrad.	H	T	N	AME	TDF, THF, POF
* *Paspalum convexum* Flüggé	H	T	N	AME	TDF, THF, POF
Paspalum mutabile Chase	H	T	N	END-MEX	POF, THF
* *Paspalum notatum* Flüggé	H	T	N	AME	OF, POF
Paspalum plicatulum Michx.	H	T	N	AME	TDF, THF, OF
Paspalum pubiflorum E. Fourn.	H	T	N	NOA	POF,AV
Pennisetum polystachion (L.) Schult.	H	T	N	COS	TDF
Peyritschia deyeuxioides (Kunth)Finot	H	T	N	AME	OF, POF
Piptochaetium fimbriatum (Humb., Bonpl. & Kunth) Hitchc.	H	T	N	NOA	OF, POF, PF, POF
Piptochaetium seleri (Pilg.)Henrard	H	T	N	MEX-CEAM	OF, POF, PF, POF
Piptochaetium virescens (Kunth)Parodi	H	T	N	MEX-CEAM	POF, POF
* *Poa annua* L.	H	T	I (Eu)	COS	TDF, THF
* *Polypogon viridis* (Gouan) Breistr.	H	T	I (Eu)	COS	OF, POF, POF
* *Schizachyrium brevifolium* (Sw.) Buse	H	T	N	AME	OF, POF, TDF
Schizachyrium sanguineum (Retz.) Alston	H	T	N	AME	TDF, OF
* *Setaria parviflora* (Poir.) M. Kerguelen	H	T	N	AME	POF, OF, TDF, THF
Setaria pumila (Poir.) Roem. & Schult.	H	T	N	AME	OF, POF, TDF
* *Setaria verticillata* (L.) P. Beauv.	H	T	N	AME	TDF, OF
* *Setariopsis auriculata* (E. Fourn.) Scribn.	H	T	N	AME	TDF, THF
Setariopsis latiglumis (Vasey) Scribn.	H	T	N	END-MEX	TDF, POF
* *Sorghum bicolor* (L.) Moench	H	T	N	COS	TDF, THF
* *Sorghum halepense* (L.) Pers.	H	T	I (Eu)	COS	TDF, THF
Sporobolus atrovirens (Kunth) Kunth	H	T	N	END-MEX	HV, TDF, THF
Sporobolus coromandelianus (Retz.)Kunth	H	T	I (Af)	COS	TDF, HV
* *Sporobolus indicus* (L.) R. Br.	H	T	N	AME	TDF
* *Sporobolus pyramidatus* (Lam.) C.L. Hitchc.	H	T	N	AME	TDF, POF, HV
Tripsacum dactyloides (L.) L.	H	T	N	NOA	TDF, POF
Tripsacum maizar Hern.-Xol. & Randolph	H	T	N	END-MEX	TDF, POF, AV
* *Urochloa meziana* (Hitchc.)Morrone & Zuloaga	H	T	N	END-MEX	POF, TDF, AV
Urochloa plantaginea (Link)R.D. Webster	H	T	N	NOA	POF, TDF, PF
* *Vulpia myuros* (L.)C.C. Gmel.	H	T	I (Eu)	COS	OF, POF, POF
Potamogetonaceae					
* *Potamogeton nodosus* Poir.	H	A	N	COS	AV
Typhaceae					
* *Typha domingensis* Pers.	H	A	N	COS	AV
Zingiberaceae					
Hedychium coronarium J. Koenig	H	T	I (As)	PAN	AV